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The Astoria Tunnel under the East River, New York City

By Harold Carpenter*

About fifteen years ago the Consolidated Gas Co., of New York City, for various reasons was compelled to look for a new site, outside of Manhattan and the Bronx, for future extensions of its operating plants. The impracticability of extending its existing plants, and the fact that many of its New York plants are located along the water front in the way of proposed water-front improvements by the city and are liable some day to be condemned by the city for public use, were among the reasons which required this action. Up to the present, three of the company's plants have already been taken by the city for such purposes.

The company accordingly purchased about 400 acres of land at Astoria (on the northwest corner of Long Island and about a mile and a half above Hell Gate) and designed a layout of plants suitable to the property, which at some future time will be capable of manufacturing all the gas used in Manhattan, the Bronx and parts of Long Island. The ultimate future capacity of this plant will be 240,000,000 cu.ft. of gas in 24 hr., larger than any similar works in the world. Of this layout, units of a capacity of 40,000,000 cu.ft. in 24 hr. have already been built and are in operation (see Fig. 2).

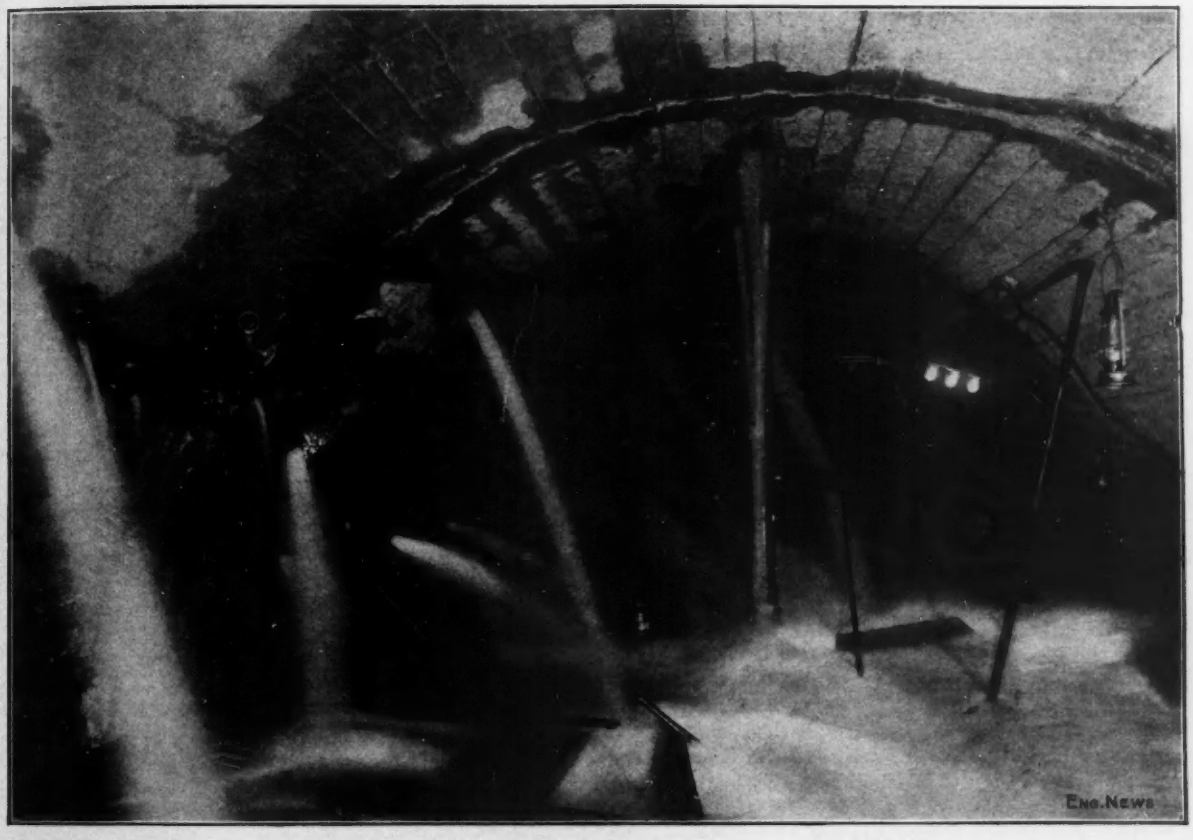

Fig. 1. A Heavy Flow of Water in the Astoria Tunnel

(Feb. 8, 1913. Flow at this time 4400 gal. per min. The flow from a bad seam at left corner of face is bulkheaded off, and the water has backed over the arch and flows in through grout pipes. This section of heading was temporarily lost.)

Up to the present time the gas manufactured at Astoria has been conveyed to New York City by means of a 5-ft. main running from the Astoria plant south about 2½ miles to the Ravenswood works and two 3-ft. pumping mains from there through the East River Gas Tunnel,* which was completed in 1894, to 71st St., Manhattan.

The plans for the plant, however, necessitated the building of a large tunnel directly from Astoria to the growing northerly district of New York City, the bor-

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*See "Engineering News" of Mar. 1, 1894, p. 172, for a general description of this tunnel.

ough of the Bronx. Due to the enormous increase in population of that borough, from 88,908 in 1890 to 430,980 in 1910 it became necessary to begin the construction of this tunnel at once. Work was started in the fall of 1910, and the tunnel is now completed except for finishing operations. During its construction the Bronx population has further increased to nearly 600,000.

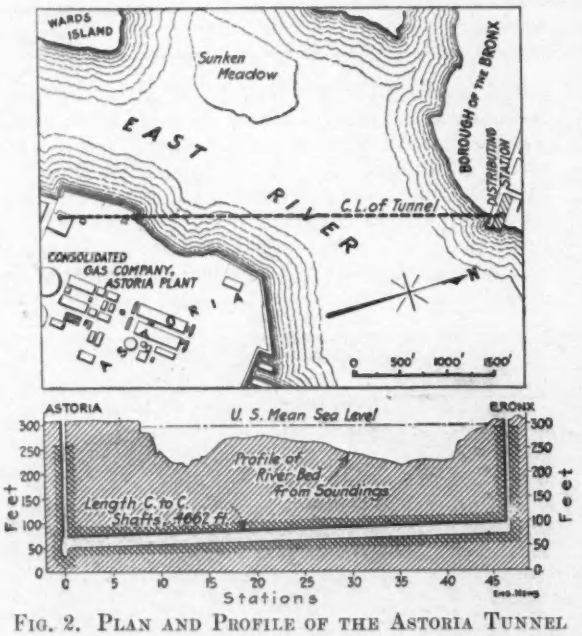

FIG. 2. PLAN AND PROFILE OF THE ASTORIA TUNNEL

This tunnel is of special interest, partly on account of its size, the size of the gas mains to be installed, but above all for the very unusual difficulties met and overcome during its construction.

GENERAL DESCRIPTION

The Astoria Tunnel extends under the East River, from the Astoria Plant of the Consolidated Gas Co., at Astoria, Long Island, to the future distributing station at East 132nd St. and East River, Bronx. The Astoria shaft is about opposite 120th St., Manhattan (see Fig. 2).

The tunnel runs in an almost north and south line, the line being exactly 16° 4′ 53″ east of north, and is 4662 ft. long c. to c. shafts. The Astoria shaft is 34 ft. 6 in. diameter and 276 ft. 9 in. deep and the Bronx shaft is 26 ft. diameter and 233 ft. deep. The total developed length of tunnel and shafts is 5171.79 ft.

The tunnel has a downgrade toward the Astoria shaft of 0.5% (a 23-ft. total fall), so that all drainage will be pumped from the Astoria shaft (see profile in Fig. 2).

The cross-section (Fig. 3) is D-shaped, except that the bottom is slightly concave, and is made up entirely of arcs of circles, the excavated section having a width of 19 ft. 9 in. and a height of 21 ft. Both the shafts and tunnel are lined throughout with concrete from 18 in. to 36 in. thick. In the tunnel this lining is reinforced with steel rods where necessary through bad ground, and one section of 50 ft. was reinforced with cast-iron lining back of the concrete. The completed cross-section of tunnel inside of concrete lining has a width of 16 ft. 9 in. and a height of 18 ft.

There is a minimum cover of 125 ft. of rock between the bed of the river and roof of tunnel. The maximum water depth in the river is 90 ft. below mean sealevel (see profile, Fig. 2).

GEOLOGICAL FORMATION

The general geological formation consists of Fordham gneiss at both the Astoria end and the Bronx end of the tunnel with Inwood dolomite between them.

Borings to a depth below the invert of the tunnel at the Astoria end, as well as numerous other borings at the gas plant, including one 2000-ft. hole for a well, showed solid rock from a point 50 ft. below the surface; a test shaft at the Bronx end disclosed bedrock 13 ft. below surface. Wash borings in the bed of the river disclosed rock at depths varying from 25 ft. to 90 ft. below mean sealevel.

From geological information available, including that determined by the East River Gas Tunnel built in 1894, it was known that trouble might be encountered on the westerly contact between the dolomitic limestone and the Fordham gneiss, but by carrying the tunnel through at as low a level as other considerations made possible, being over 100 ft. lower than the old tunnel, it was hoped to minimize this difficulty.

The Astoria shaft and the south end of the tunnel extended through Fordham gneiss of varying characteristics up to a point about 1200 ft. from the shaft, where Inwood dolomitic limestone was encountered (see Fig. 6). This gneiss had a strike varying from 25° to 55° east and variable dip and contained seams and dikes of kaolinized gneiss and pegmatite, the former appearing especially on the contact between the gneiss and limestone.

The Bronx shaft and the north end of the tunnel extended through Fordham gneiss of varying characteristics up to a point about 750 ft. from the shaft, where Inwood dolomitic limestone was encountered. The gneiss was very uniform until at 600 ft. from the shaft a fault was found. At 650 ft. the first watery crevice occurred, and at 715 ft. seams filled with decomposed rock began to occur, becoming serious at the actual dolomite contact, 750 ft. from the shaft. The 400-ft. stretch beyond this latter point constitutes the trouble zone which will be described later.

Returning to the easterly contact between the Fordham gneiss and Inwood dolomite, 1200 ft. from the Astoria shaft: From this point northward to the southerly end of the trouble zone the limestone contained many igneous and metamorphic dikes and intrusions. Seams and dikes of kaolinized gneiss, decomposed limestone and chlorite; kaolinized limestone, mica and iron pyrites; quartz, white feldspar and mica; feldspar, quartz and mica with pure talc on either side; serpentine and asbestos, talc; granite from 5 ft. to 10 ft. wide; white and smoky quartz 12 ft. wide; gneiss; quartz and feldspar; and a dike of granite about 25 ft. wide; occurred in about the order named.

Among specimens found in different places throughout the tunnel including the trouble zone were: Garnets in the gneiss, seams of pure asbestos about ¼ in. thick, seams of pure talc 4 in. thick, actinolite, biotite, beautiful specimens of calcite crystals, differently colored dolomitic limestone (white, gray, brown, green, etc., both crystalline and noncrystalline), siliceous limestone, chlorite, hematite, hornblende, iron pyrites, kaolin, limonite, mica in transparent white sheets, muscovite, oligoclase

orthoclase, quartz, both white and smoky pegmatite, serpentine, tourmaline, tremolite. There were found also pockets of clay ranging in color gray, blue and red; seams of decomposed limestone; green and black mud and sand; and beach sand.

A number of anticlinal and synclinal folds were encountered.

Progress

Ground was broken for both shafts on Sept. 12, 1910, and, as the gneiss and limestone made a good rock for shaft-excavation and tunneling, good progress was made. The Bronx heading was turned on Feb. 12, 1911, and the Astoria heading on April 8, 1911.

The best progress in shaftsinking occurred in the month of March, 1911, at the Astoria shaft, with 52 ft. of shaft excavated in 25 working days, amounting to 2428 cu.yd. of rock in place, or 97 cu.yd. per working day.

The best average daily progress in the tunnel heading was at the Astoria end in May, 1912, with 17 ft. per working day of 24 hr., in three shifts. This meant the excavation of 100 cu.yd. of rock in place, and constitutes the world's record for volume of heading excavation. The heading was practically semicircular, constituting the entire upper part of the tunnel, and was driven at this time through Inwood dolomite sufficiently hard so that it was crushed and used again in the concrete lining.

By a peculiar coincidence nearly the same record was being made at the same time on the Montreal tunnel of the Canadian Northern Ry., where an 8x12-ft. heading was driven an average of 26 ft. per day, giving 93 cu.yd. of rock in place removed per day. This heading was driven through Trenton limestone, very similar to the Inwood limestone of New York.

Records of progress in tunnel headings are most often given in terms of lineal feet per day, and on this basis the Loetschberg tunnel in Switzerland with its record average of 32.6 ft. per day holds the world's record. On the same basis the Laramie-Poudre tunnel, where a maximum progress of 21 ft. per day in a heading 7½ ft. by 9½ ft. was made, is credited with the American record.

This basis of comparison, lineal feet per day, is often misleading, and the size of the heading, character of rock, etc., should be taken into consideration in making any comparisons. The Loetschberg heading was only 6½ ft. by 10 ft., and taking volume displaced would only give 79 cu.yd. per day, through soft triassic limestone. The Laramie-Poudre tunnel reduced to volume displaced gives only 56 cu.yd. per day.

It seems to the writer that cubic yards excavated in similar rock, under similar conditions, is the only fair basis upon which to make comparisons. In the Astoria Tunnel, in addition to the regular work connected with the removal of the 100 cu.yd. per day, an average of 96 lin.ft. of deep test-holes had to be drilled each day to prospect ahead for possible trouble, which often delayed the work; and besides this, 126 cu.yd. of rock from the bench were removed over the same tracks, and the whole spoil was raised up a shaft 276 ft. deep for removal.

The maximum progress of full-section tunnel excavation was also 17 lin.ft. per day, with 226 cu.yd. in place excavated.

On the Wallkill Pressure Tunnel of the Catskill Aqueduct, which was driven through Hudson River shale, a record of 17 lin.ft. of completed tunnel excavation per day was made, and this was claimed to be the best progress made to date in the United States on a tunnel of this size in hard rock. Reduced to cubic yards in place this gives 169 cu.yd. excavated per day, against 226 cu.yd. at Astoria. The Laramie-Poudre tunnel also made a regular average of 17 lin.ft. of completed tunnel excavation per day, amounting to 45 cu.yd. of rock in place, the tunnel really being nothing more than a small heading. This was accomplished under conditions of very high wages with a liberal bonus system.

During the six months ending Sept. 1, 1912, the Astoria tunnel was advanced an average of 255 lin.ft. per month. Part of this time was taken up placing the concrete lining, so that the progress stated was made in 19 working days per month, or at the rate of 188 cu.yd. per day, against 169 on the Wallkill tunnel.

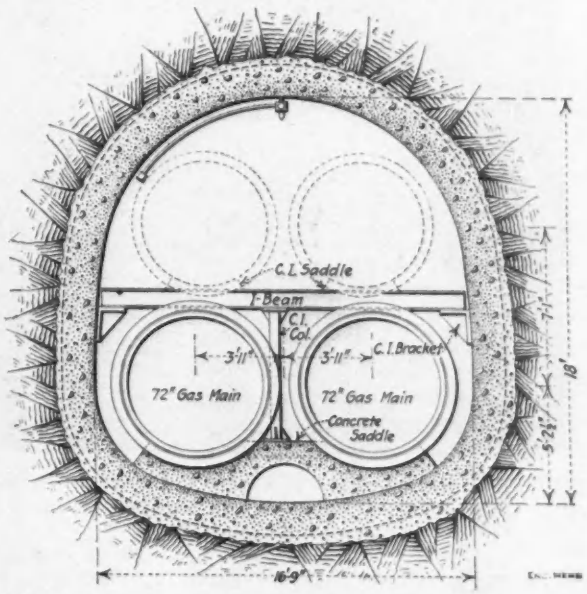

Fig. 3. Cross-Section of Astoria Tunnel, Showing Pair of 72-In. Mains and Future Additional Mains

Construction Plant

A very complete construction plant was installed at both ends of the tunnel. In anticipation of possible trouble a much larger boiler plant was installed than would otherwise have been necessary. It consisted of 1200 hp. at the Bronx end and 1800 hp. at the Astoria end, about three times as much as was required to operate the plant outside of pumps. The necessity for such a large installation was afterward proved, as both boiler plants were used to the limit of their capacity in handling the water.

Ingersoll-Rand compressors capable of compressing 3300 cu.ft. of free air per minute were installed at each end for operating drills, pumps, etc., and two 50-kw. generators at each end for lighting the terminal plant and tunnel. Cameron pumps of a capacity of 1000 gal. per min. were installed in the Bronx shaft, and a capacity of 1400 gal. per min. in the Astoria shaft.

Ingersoll-Rand rock-drills were used throughout, the heading being drilled from columns and the bench in the usual way from tripods.

Two muck elevators and one passenger elevator were placed in each shaft. The separate passenger cages, while unusual in such work, were installed for the safety of the men. Every possible precaution and safety device was provided, either included in the original plant or added during the progress of the work.

An emergency hospital with ward capacity of six beds, operating room, kitchen, bath and doctor's room was built especially to take care of accidents on the tunnel work. Orderlies were on duty day and night and a surgeon on call at each end. These precautions resulted in a record of only two deaths since the tunnel was first started, extending over a period of nearly three years, which is believed to be a record on similar work.

FIG. 4. ASTORIA HEADING: ONE OF THE TWO MAIN EMERGENCY BULKHEADS CONSTRUCTED AT EACH END OF TROUBLE ZONE

(Steel drop door, man lock for escape; 3138 ft. from shaft. Looking down slope of inclined platform, toward inner face of bulkhead.)

FIG. 5. ONE OF THE EMERGENCY BULKHEADS CONSTRUCTED AT ASTORIA HEADING ON TOP OF THE BENCH TO PROTECT SHORT SECTIONS OF COMPLETED HEADING

(With steel drop door; 3692 ft. from shaft.)

The Trouble Zone

The first indications of bad ground were encountered at the Bronx end on nearing the westerly gneiss-dolomite contact, the latter part of July, 1911, at a point 700 ft. from the shaft. In the gneiss, small seams of decomposed limestone and some water appeared in the heading. A month later the first water under high pressure appeared in a test hole in the east side of the heading. Holes were drilled and piped, and an attempt was made to force grout into the seams under from 100 to 125 lb. pressure (against a head of about 90 lb.), without success; little grout went in, the pressure employed being apparently insufficient.

On the morning of Aug. 29, 1911, a section of the wall caved in, followed by a heavy flow of green sand (decomposed limestone) and about 1000 gal. of water per minute. This partially flooded the tunnel to the shaft, and the grade being down toward the heading, the water stood 6 ft. deep at the face of the bench. For a time the pumps just held the water; then a choking of the seam occurred and the flow diminished. A solid concrete bulkhead was built across the heading, with pipes [illegible]nding through it to drain the water and to grout thro[illegible] after the bulkhead had set. An emergency bulkh[illegible] was built 670 ft. from the shaft over the entire s[illegible]on of tunnel with a manlock for the escape of men f[illegible]m the heading and two doorways for cars fitted with [illegible]ne-ton steel doors arranged to trip and drop instantly [illegible] case of a flood to protect the completed tunnel an[illegible] shaft. (Fig. 4 shows a one-door emergency bulkhead, built a year later, in the other end of the tunnel.)

During this flood about 1000 cu.yd. of green s[illegible]d and mud came in, together with beach sand and shell[illegible]

Additional pumps were installed, increasing the capacity to 2200 gal per min., and a grouting plant capable of grouting under 200-lb. air pressure was put in. After solidly grouting up the heading behind the bulkhead, a small drift was started through the west side of it to regain the original heading face, which was reached Oct. 9, 1911; but progress regaining the east side of the main heading was extremely slow. After many difficulties, and another heavy flow in the early part of November, when 2000 gal. per min. was pumped and water was 4 ft. deep at the face of the bench, it was decided to run some diamond-drill core borings ahead to determine the extent and location of the trouble. Several 200-ft. holes were drilled. They showed that the trouble extended at least that distance ahead and crossed the line of excavation at an angle so that it would be necessary to cross it with the entire excavation. These holes were completed Dec. 30, 1911.

Widening of the main heading was then resumed. Segmental timbers 10x10 in. were slowly placed back of the concrete lining; steel reinforcing rods were used in the concrete. The main heading reached the previous face on Feb. 9, 1912, and thus five months' delay had been incurred up to this time.

Discontinuing Bronx Heading Work

Work was continued at the Bronx end under great

difficulty and with very little progress, until Aug. 27, 1912. On that day it was decided to discontinue the heading at this end, on account of difficulty of handling floods here (the drainage of the tunnel being toward the heading) and the greater ease of handling water at the Astoria end.

During the period from August, 1911, to August, 1912, at the Bronx, one year, the heading was advanced 112 ft, a number of large flows of water occurred, and four times the heading was partially flooded. The pumping plant had gradually been increased to 4000 gal. per min. Seven temporary bulkheads had been constructed (either entirely across the heading or across sections of it); 14,679 bags of cement had been used in grouting seams, and 1689 bags in grouting behind bulkheads. During one of the flows of water coal came into the heading, apparently from a coal barge which had sunk in the vicinity, indicating that the connection with the river was probably close at hand, although no indication of air escaping during grouting under 200 lb. pressure could be discovered.

FIG. 6. FORDHAM GNEISS INCLOSED BY INWOOD DOLOMITE ON EACH SIDE; ASTORIA HEADING
(1254 ft. from shaft)

FIG. 7. FLOW FROM BEHIND DAM OF BAGGED CEMENT IN A SIDE DRIFT, ASTORIA HEADING
(Water flowing through two 8-in. and three 6-in. drain pipes. Getting ready to build bulkhead. Maximum flow 6000 gal. per min.; 3655 ft. from shaft.)

INCREASING ASTORIA PLANT

Preparations were now made at the Astoria end to meet emergency conditions. The pumping plant was increased to a capacity of 6200 gal. per min., and, as the experience at the Bronx end seemed to show that 200 lb. pressure was not sufficient for grouting, a plant was installed at Astoria for grouting under 500 lb. pressure. An emergency bulkhead similar to the one at the Bronx end was installed at a point 3138 ft. from the Astoria shaft with a long settling basin inside of it for catching the mud and sand, and an inclined trackway leading up to the top of the bench. (See Fig. 4.)

STRIKING TROUBLE AT THE ASTORIA END

On Nov. 6, 1912, at a point 3500 ft. from the shaft, the first serious trouble was encountered when one test-hole gave a flow of 1000 gal. per min. under full pressure. A small drift was started on the east side of the heading, so that holes could be drilled into the seam along the west side of this drift, and grouted, for advancing the main part of the heading. Between this point and the first trouble at the Bronx end there was about 400 ft. of very bad ground along the contact seams which crossed the excavation diagonally from southwest to northeast at an angle of about 35° east of north.

At this point a test of the 500-lb. pressure grouting showed it to be very much more effective than 200-lb. grouting, placing twenty times as much grout in a single test-hole.

METHODS OF HANDLING THE DIFFICULTIES

From this first entry into the the trouble zone at the Astoria end until the heading was "holed out," on July 17, 1913, progress was made with the greatest difficulty. Large flows of water with mud and sand occurred continually. The general methods used were as follows:

A large number of long test-holes was drilled ahead of any advance. When water was struck in these holes, pipes wrapped in bagging and with valves on the end were driven into the holes with hammers or by drill machines and wedged tight into the rock with steel wedges, bagging and oakum. The mud and sand would then be allowed to drain out of the seams, and thereupon grout would be forced into these holes and allowed to set. Then more holes were drilled and the process repeated, until no water could be located, when a small advance would be made. Where water was expected, large holes were drilled, long enough to place the pipes, then the pipes with valves on the ends would be driven and wedged in as described, and the hole drilled into the water through the pipe, so as to avoid the difficulty of placing pipes against the pressure. Sometimes in spite of this exploration when an advance was started the shooting would seem to start the flow of water, where none had appeared before, resulting in a large flow; in such cases a bulkhead would have to be built, under the greatest difficulties, and the space behind it grouted up and the advance started over again.

When the main heading could not be advanced on account of too bad conditions, side drifts would be run and the seams grouted by means of a great number of holes drilled in the side of the drift.

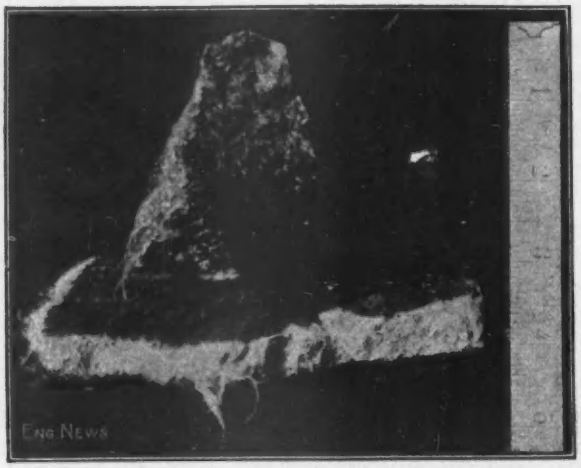

FIG. 8. PIECE OF DOLOMITE WITH GROUTED SEAM
(Grout mixed with waste, and forced in under 500 lb. pressure—white portion.)

GROUT WITH COTTON-WASTE ADDITION—To stop small leaks around pipes and assist in grouting small seams, oats and bran in the grout were tried, following precedent. They did not give success, however. Cotton waste chopped fine and mixed with the grout was finally tried, and proved very effective, so that it was adopted and large quantities of it used. It is believed that this was the first use of waste for this purpose.

HEAVY INFLOW OF WATER—During January and February, 1913, a flow of water which started at 200 gal. per min. suddenly increased, due to a very light shot in the drift some distance away, to 4000 gal. per min. (See Fig. 1, on front page). Three bulkheads had to be constructed, one behind the other (the first two failing in turn), before this flow could be controlled; over 1000 cu.yd. of sand came into the tunnel; 16 ft. of heading and 45 ft. of drift were temporarily lost and had to be grouted solid. From Feb. 7 to Mar. 3, 1913, the average pumpage was over 3000 gal. per min. and the maximum 4400 gal. per min.

FISH FROM THE RIVER—On April 1, 1913, while running a side drift another great flow occurred (see Fig. 7), and 25 ft. of drift was lost. A bulkhead was built across the drift. During the next week the average pumpage was 4800 gal. per min. and the maximum 6000 gal. per min. For several days live fish came through the leak by the hundreds and were taken home by the workmen.

GROUTING UNDER 500-LB. PRESSURE—This seam was grouted under 500-lb. pressure with 3800 bags of cement, the most successful grouting accomplished at any time during the whole work. During this grouting air bubbles appeared on the surface of the river directly over the line of tunnel and a little north of the heading, being the first such indication of the obvious connection between tunnel and river. When grouting was discontinued the bubbles disappeared.

LESS WATER—As this flood had taxed the capacity of the pumping plant it was increased once more, to 7700 gal. per min. capacity, and forced draft was installed in the boilers. The heading was then continued, through the worst ground yet encountered, but only one heavy flow of water (2400 gal. per min.) occurred, the last grouting evidently having shut off the main supply.

From this point on considerable quantities of grout in seams of the rock appeared in the heading, for the first time, as previously the grout had seemed to go outside the excavation line. Seams of green sand and rotten rock as wide as 5 ft. were encountered, and at times the entire face of the heading was a mass of sand and rotten rock so that it could be largely removed with a pick, and much of it could be pulled out with the hand.

A CAVITY IN THE ROCK—At one point an empty pocket 10 ft. wide, 8 ft. high and 10 ft. deep, with another hole running off from it along the contact between gneiss and limestone 4 ft. high, 8 ft. wide, and 8 ft. deep, was encountered. This great cavity had probably been washed empty during one of the floods of water and mud.

Three additional emergency bulkheads with drop doors (see Fig. 5) were built across the heading to protect

FIG. 9. ASTORIA HEADING DRIFT HOLED THROUGH TO THE BRONX HEADING
(July 17, 1913; 3741.7 ft. from Astoria shaft.)

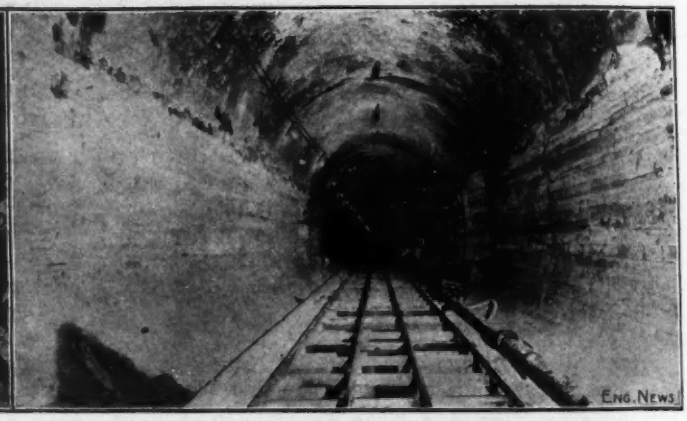

FIG. 10. A COMPLETED SECTION OF ASTORIA TUNNEL
(Bronx end; with construction tracks on the invert. Concrete saddles for pipes not yet placed.)

short stretches of completed heading, and 22 temporary bulkheads across the main heading or across corners of it were constructed at the Astoria end to control the water.

Amount of Grouting Done—In all, the work in the Astoria end consumed 14,414 bags of cement in grouting seams, and 5550 bags in grouting behind bulkheads. Adding to this the amount which had been used in the Bronx end makes a total at both ends for seams of 29,093 bags and behind bulkheads of 7239 bags, or a grand total of 36,332 bags or 9083 barrels used merely for grouting seams and bulkheads.

The Tunnel Holed Through

The heading was "holed out" on July 17, 1913, at 3:35 p.m. The last shot was fired by George B.

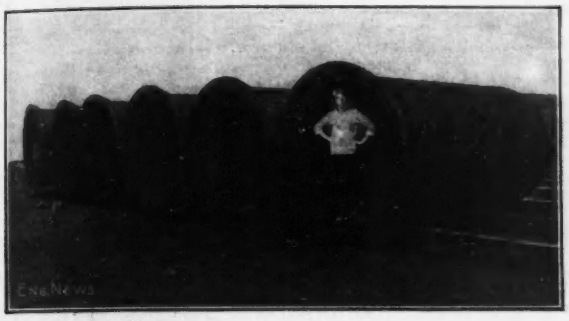

Fig. 11. The 72-In. Gas Mains, the Largest in the World, Which Are to Be Installed in the Astoria Tunnel

Cortelyou, President, and Wm. H. Bradley, Chief Engineer, of the Consolidated Gas Co.

High-Pressure Grouting

Grouting with high-pressure air was developed on this work beyond anything ever before attempted. The highest air pressure previously used for this purpose was used on the Rondout Pressure Tunnel of the Catskill Aqueduct, where a pressure of 300 lb. was used, as compared with 500 lb. at Astoria. Hydraulic grouting has been done to a small extent with greater pressure. The largest hydraulic pressure used for this purpose was on the Hudson River Siphon of the Aqueduct where 1000 lb. pressure was used, the leak, however, only amounting to 150 gal. per min. A pump was used in that case because air compressors for that pressure could not be secured.

Difficulties Overcome

It is believed that greater difficulties were encountered and overcome in the 400-ft. trouble section of the Astoria Tunnel than on any other similar work. Probably the nearest approach to the water conditions, considering those cases in which tunnels were carried through the trouble rather than around it, was on the Rondout Siphon mentioned above, where the greatest flow of water encountered was 2000 gal. per min. under 85-lb. head; this is to be compared with a maximum flow of 6000 gal. per min. under 90-lb. head at Astoria.

Alignment

The alignment of the tunnel checked within ¾ in. and the grade within ⅜ in.

Gas Mains

Two 72-in. (inside diameter) cast-iron gas mains will be laid at present and two more mains later when needed. The mains are made up of sections 12 ft. long and 2½-in. thickness of wall, and each section weighs 13 tons. They will be the largest gas mains in the world. The pipes will be supported on 771 concrete saddles, each weighing over a ton. The joints will be calked with lead wool by means of a special pneumatic calking machine operated from the top of the pipe.

It will take about one year to finish excavating and lining the tunnel and laying the gas mains.

Organization

The entire work of engineering, organization and construction is being carried on by the Consolidated Gas Co., of New York, through its subsidiary, the Astoria Light, Heat & Power Co., under the direction of William H. Bradley, Chief Engineer; W. Cullen Morris, Engineer of Construction; and Harold Carpenter, Resident Engineer; by Jacobs & Davies, Inc., Consulting Engineers, who engineered the Pennsylvania R.R. Hudson River tunnels, the Hudson & Manhattan Ry. tunnels and other similar work in other parts of the world. Mr. Vivian Messiter, Engineers' Agent, is in charge for Jacobs & Davies.

A Steel Chimney to increase the height of an existing brick chimney has been put in place on the Borland Building, Chicago (at Federal and Harrison Sts.) The steel extension is about 100 ft. high and 9 ft. diameter. It was raised in one piece to the top of the building and set in place on the brick chimney by a derrick having a spliced beam about 140 ft. long.

Locomotive No. 40,000 built by the Baldwin Locomotive Works was completed recently, being an engine of the 4 : 6 : 2 class for fast and heavy passenger service on the Pennsylvania R.R. The first locomotive built by this firm was completed in 1832, and its No. 1000 in 1861, No. 5000 in 1880, No. 10,000 in 1889, No. 20,000 in 1902 and No. 30,000 in 1907. The first locomotives were built at a small shop in Lodge Alley, Philadelphia, but in 1835 a shop was built on the site of the present plant at Broad St., which plant now covers over 17 acres and has 38 buildings with 38½ acres of floor space. As this plant could not be further enlarged, a site for a new plant at Eddystone, Penn. (12 miles from Philadelphia) was purchased in 1906. This has an area of 225 acres, and extensive shops have been built upon it, with about 30 acres of floor space. A site of 370 acres for works at East Chicago, Ind., was purchased in 1911, but no locomotive shops have yet been built; a plant for making steel tires and wheels has been established on this site by the Standard Steel Works Co., in which the Baldwin firm owns a controlling interest. The Baldwin Locomotive Works now employ about 1900 men and can build about 2500 locomotives per year.

Engine No. 40,000 is one of an order for 30 engines, and is equipped with Belpaire firebox, Walschaerts valve gear, Schmidt superheater and Crawford underfeed mechanical stoker. The general dimensions are as follows:

Driving wheels	6 ft. 8 in.
Truck wheels	3 ft. 0 in.
Trailing wheels	4 ft. 8 in.
Wheelbase, driving	13 ft. 10 in.
Wheelbase, engine	35 ft. 2 in.
Wheelbase, engine and tender	60 ft. 2 in.
Weight on driving wheels	189,500 lb.
Weight on leading truck	46,100 lb.
Weight on trailing truck	57,600 lb.
Weight of engine	293,200 lb.
Weight of engine and tender	475,000 lb.
Cylinders	26x26 in.
Boiler, straight top, diameter	6 ft. 8 in.
Working pressure	205 lb.
Firebox	9 ft. 2 in. x 6 ft. 0 in.
Tubes, steel, length	21 ft. 0 in.
Tubes, No. and diameter	32, 5½ in.; 202, 2¼ in.
Heating surface, tubes	3453 sq.ft.
Heating surface, firebox	204 sq.ft.
Heating surface, arch tubes	23 sq.ft.
Heating surface, total	3680 sq.ft.
Superheating surface	845 sq.ft.
Grate surface	55½ sq.ft.
Coal on tender	24,600 lb.
Water on tender	8000 gal.

The Adjustment of the Devices at Hinge, Miter Ends and Sills of Panama Canal Lock Gates to Prevent Leakage

The Panama Canal lock gates are the largest and most massive hinge gates ever constructed, and their design, erection and adjustment presented many unique engineering problems. The design of these gates was described in an article in our issue of Sept. 16, 1909, which

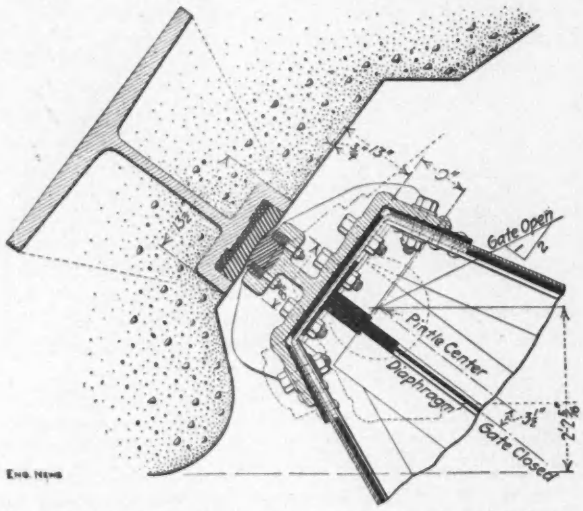

FIG. 1. DETAILS OF THE MITERING DEVICE AT HINGE OF PANAMA CANAL LOCK GATES

gave in some detail the proposed methods of insuring watertight joints. The following article, reprinted with some slight changes from the "Canal Record" of Aug. 6, 1913, shows how the design was executed and how well every detail fulfilled the purpose of its design.

The detail work of preparing the design of the gates was carried out under the direction of Henry Goldmark, Designing Engineer; and the construction and erection of the structural steel of the gate leaves was done under the supervision of L. L. Jewell, Manager of Erection for the contractor, the McClintic-Marshall Construction Co., of Pittsburgh, Penn., until September, 1912, and since then under the supervision of W. M. Sterrett, the successor of Mr. Jewell, who resigned to become President and Chief Engineer of the Central American Construction Co.

On June 14, the lower guard gates at the Gatun locks, Panama Canal, were closed and water let into the forebay, which had separated the sections of the channel, to the full height to which the gate leaves will be subjected when the canal is in operation. As the water began to rise against the outer faces of the gates, they showed only slight leakage, and the pressure of the full head of 42 ft. of water forced the mitering leaves so closely together that the slight initial leakage soon ceased. These gates may be said to be practically watertight.

Each of the four leaves of these gates is 65 ft. long, 7 ft. thick, 47 ft. 4 in. high, and weighs 390 tons.

Throughout their construction, special care was taken to perfect their alignment and make them fit exactly. A special machine was installed at the works of the contractor in the United States, by which both ends of the horizontal girders were planed at the same time. This machine remained unchanged until all the girders were completed.

As the skeletons of the leaves were erected in the locks their alignment was constantly checked with fine steel wires; it is believed that their greatest deviation from a pl[illegible] line does not exceed ½ in. for any of the leaves, even be[illegible] the end castings are attached and the bearing plates adju[illegible].

At the top of every fourth panel from the bottom, [illegible]ust-able fillers were set between the vertical diaphragms [illegible] the girders above, in order to keep companion leaves at th[illegible]ame height; the heights of all completed gates agree withi[illegible] in.

The stiffness of the leaves is so great that the total [illegible]flec-tion at the bottom has never exceeded ¼ in., when the [illegible]aves were set on pintle and anchors, and swung repeatedly t[illegible]ugh full movements, without the buoying force of the wa[illegible] by which the stresses will be lessened when the gates [illegible] in actual operation.

The careful construction and erection of the str[illegible]ural steel made possible a very exact adjustment of the [illegible]ickel steel bearing plates along the vertical ends of the leav[illegible]. Indeed the closeness of the joints between the two leaves [illegible] the mitering ends, and with the fixed castings at the hinge [illegible]nds, is regarded as unprecedented in large scale steel construction.

The adjustment at the hinge or quoin ends of the l[illegible]aves is indicated in the accompanying Fig. 1. The heavy steel castings (shown in light cross hatching) were embedded in the lock walls as they were built.

These castings contained machined recesses at the end toward the lock chamber; the bearing plates of the hollow quoins (shown in dark hatching) were set in the recess and attached to the castings by 1-in. bolts, spaced 17 in. apart, while temporary stud bolts were placed at intervals of about 2 ft. along the center line of the plates to assist in the adjustment.

The exact center of the bearing plate was determined by a plumb line placed directly over the center of the steel pintle on which the bottom of the leaf was later to be placed.

After the plates were so exactly aligned that the deviation from exact correctness nowhere exceeded 0.005 in., melted babbitt metal was poured into the space between the bearing plates and the heavy steel castings embedded in the wall. The babbitt metal was poured through bolt holes about 4 ft. apart, vertically. To avoid explosions from dampness and insure exact filling, hot compressed air was first blown into the space. Finally, the joints between the bearing plates and the steel castings were calked.

Corresponding bearings were provided in the end of the gate leaf. Heavy steel castings (shown in light hatching in Fig. 1), with recesses at the outer ends were securely riveted to the leaf, and to these bearing plates were attached by means of bolts. The gate leaf was then set on the pintle, as for operation, and swung to its closed position. The bearing plates on the leaf were forced closely against the fixed bearing plates in the wall castings, and held by means of adustable bolts. The leaf was then swung into open position, exposing the faces of the bearing plates, and the latter were babbitted in the manner used for the fixed quoin plates, as already described.

These adjustments were always made early in the morning, to insure a uniform temperature throughout the leaf. It was expected originally to adjust the plates at the outer or

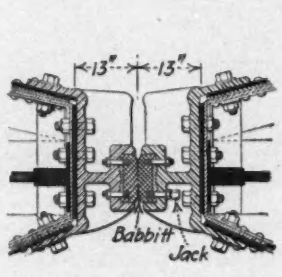

FIG. 2. MITER ENDS OF LOCK GATES

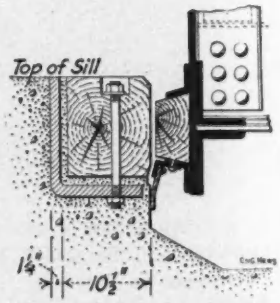

FIG. 3. SILL OF LOCK GATES (Showing Device for Watertight Joint.)

miter ends of the leaves in the same way, by bringing the two leaves of a gate to correct closed position and pressing the bearing plates against each other by means of jacks. However, the variations in the lengths of leaves from temperature changes, even within short periods, made it necessary to use another method.

In this adjustment the leaves are closed and the plates at top and bottom are brought into contact and fixed in their proper position. The leaves are then swung apart and the

remaining plates adjusted in correct alignment, as determined by means of a fine wire plumb line, with those at top and bottom. After the babbitting, the leaves are brought together again, and any small irregularities are corrected by grinding the surfaces of the bearing plates. A section of the adjusted plates of the two miter ends, in closed position, is shown in Fig. 2.

Leakage at the bottoms of the leaves has been obviated by the use of a specially designed sill, using a rubber strip along the line of contact. (Described in "Engineering News" of Aug. 8, 1912, p. 243.) A cross-section of the sill, with the leaf closed against it, is shown in Fig. 3.

As shown, a heavy timber is set in the concrete of the lock floor; this timber is not adjusted until after the quoin and miter bearings have been completely finished and the smaller timber attached to the leaf. The timbers having been adjusted, a strip of rubber, 5 in. wide and ½ in. thick, is attached to the leaf by means of an angle which is fastened to the plate below the timber cushion. The strip serves to prevent the escape of water between leaf and sill, even when for any reason the timbers are not in absolute contact. This construction is novel and has proved to be effective.

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A Gasoline Freight Locomotive

A recent interesting development of the railway-motor car is a gasoline motor freight and switching locomotive, which has been put in service for yard work and road work on the Minneapolis & Northern Ry., is an 18-mile line extending from Minneapolis to Anoka, Minn., operated entirely by motor cars. The freight locomotive was built by the McKeen Motor Car Co., of Omaha, Neb., and its power equipment is practically identical with that of the McKeen passenger motor cars which are used on this road and are used also for auxiliary service on a large number of steam railways in this country and abroad.

The new freight locomotive, which is shown in the accompanying cut, is a four-wheel machine, with one axle driven directly from the gasoline engine, and with coupling chains (instead of rods) for driving the other axle. In the double-track passenger cars (described in ENGINEERING NEWS, Jan. 20, 1910), only one axle of the motor truck is driven, and this axle has larger wheels than those of the rear axle of the truck. The locomotive is 17 ft. long over the couplers, and 14 ft. over the end sills, with a width of 9 ft. 6 in., and a height of 12 ft. 3 in. over the radiators on the roof. The weight of 43,000 lb. is carried on four 42-in. wheels with a wheelbase of 6 ft. 6 in. The truck frames are of cast-steel, and the brake and coupler equipment conform to the M. C. B. standards. The machine carries 120 gal. of gasoline and 170 gal. of water, the former supply being sufficient for 10 hours of ordinary service. Larger tanks can be fitted if required. There are two speeds, 8 and 22 m.p.h., and the machine can haul 20 loaded freight cars on level track.

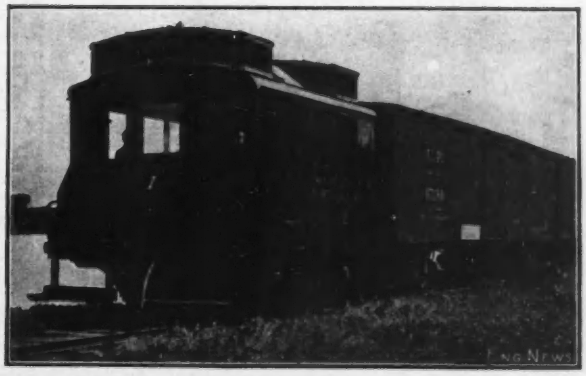
The power equipment is a six-cylinder vertical, reversible, variable-speed gasoline engine of 200 hp., having cylinders 10x12 in. The engine has an inclosed crankcase, inclosed herringbone gears, a water cooling system and a compressed-air starting device. The cooling system comprises two radiators mounted on the roof, and a geared pump driven from the engine crankshaft by a Morse silent chain. The engine is set transversely, about midlength of the machine, with the ends of its bed resting on the cast-steel side frames.

The crankshaft is in two pieces, connected at the middle by a combined coupling and sprocket wheel, from which wheel a 5-in. Morse driving chain of 2-in. pitch runs to a large sprocket wheel carried by a sleeve rotating freely upon the front axle. This second sprocket wheel is attached to the outer or driving member of a multiple-disk friction clutch of heavy construction, having 2200 sq.in. of available surface. This member of the friction clutch can be connected either directly to the axle or to a set of back gears (of the herringbone type) by means of a sliding clutch. Both clutches are operated and controlled by means of compressed-air cylinders.

In starting a train, the high torque required is secured by transmitting the power from the axle sprocket wheel through the sliding clutch and back gears to the axle. When the locomotive has been started, the sliding clutch is shifted so as to disengage the back gears and connect the axle sprocket directly to the axle. With this direct-drive position, the sprocket, clutch and axle rotate as one unit, and the only loss of power in transmission is that through the driving chain, which is 3 to 4%. On each end of the driving axle is a sprocket for a 4-in. coupling chain of 1½-in. pitch, which drives the rear axle through a similar sprocket.

The carburetor is of special design, capable of using low-grade gasolines and distillates. It has special features for insuring the proper mixtures suitable for cold and hot days. The exhaust from the engine is carried through a muffler and discharged through a stack which extends above the roof.

Compressed air is used for starting and reversing the engine, operating the control and clutches, and operating the brakes and whistle. An ample and constant supply of compressed air is necessary, therefore, and two sources of supply are provided. An air pump 5x4 in. is mounted on the engine bed and driven from an eccentric on the crankshaft, and there is an independent compressor driven by a small gasoline motor. Only one man is required to handle the engine. It seems probable that such



GASOLINE FREIGHT AND SWITCHING LOCOMOTIVE OF THE MINNEAPOLIS & NORTHERN RY.
(McKeen Motor Car Co., Omaha, Neb., Builder.)

an engine could be employed to advantage for switching service in the yards of steam railways.

It is of interest to note also that in one case a construction locomotive was improvised by taking the motor truck from a McKeen passenger motor car and building a suitable deck and housing or cab upon it. This was used for handling rails, ties, etc., during the construction of the Charles City Western Ry., in 1911, and is said to have effected a considerable saving as compared with a steam locomotive for such work.

Motor Inspection and Maintenance in Industrial Plants

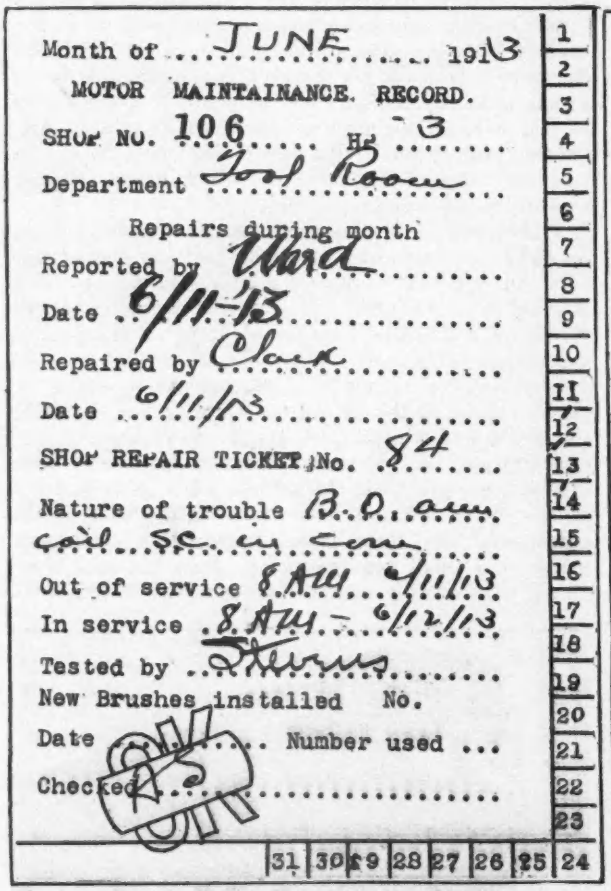
By F. E. Hanchette*

In large industrial plants where motors are extensively and in many instances exclusively, used for driving the machinery, it is a matter of the utmost importance that such motors shall receive careful attention to prevent the possibility of a stoppage of work on any machine by reason of the electrical equipment going wrong. A large percentage of time lost through this cause can be eliminated by instituting a system of daily inspection of each motor, thereby insuring continuity of service and also a saving in the maintenance cost of the motors and shop equipment.

In most plants using a large number of motors, some sort of an inspection is maintained, but in few instances carried to a point where it is either thorough or efficient, although often costing more than would a systematic inspection.

Many times trouble has developed in a motor only because the man who should have given it his attention, did not do so and thus overlooked the first signs of trouble and remedying it before it developed to serious proportions. Such a man, to cover his negligence, often makes it appear that the fault was in the motor or due to improper handling by the operative. In a majority of cases this explanation is accepted unquestioned, especially if his foreman considers him a competent and reliable workman, while the operative or the apparatus is unjustly blamed.

A regular daily inspection of every motor in a plant, no matter how many there may be, is easily accomplished, economically and efficiently. To some, before the system about to be outlined has been given careful consideration, it may seem too much like red tape, but it has been demonstrated that such a systematic inspection positively reduces the maintenance cost of the plant. It also increases the output by eliminating delays caused by defective electrical equipment, conserves the temper of the machine operative and increases his efficiency.


Month of JUNE 1913

MOTOR MAINTAINANCE. RECORD.

SHOP NO. 106 H.P. 3

Department Tool Room

Repairs during month

Reported by Ward

Date 6/11/13

Repaired by Clark

Date 6/11/13

SHOP REPAIR TICKET No. 84

Nature of trouble B.O. arm coil...S.C. in com

Out of service 8 A.M. 6/11/13

In service 8 A.M. 6/12/13

Tested by Stevens

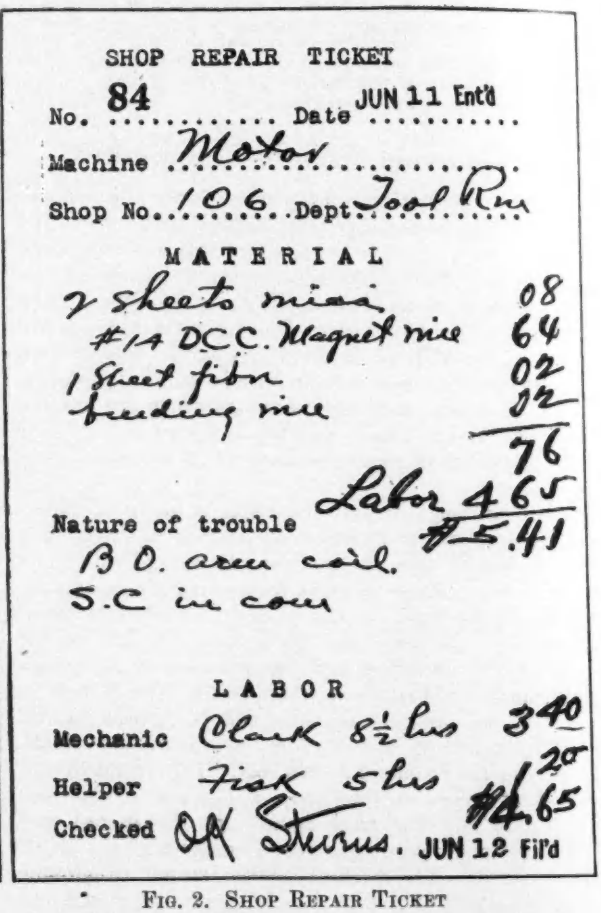
New Brushes installed No.

Date ... Number used ...

Checked ...

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Fig. 1. Motor Maintenance Record


SHOP REPAIR TICKET

No. 84 Date JUN 11 Ent'd

Machine Motor

Shop No. 106 Dept. Tool Rm

MATERIAL

2 sheets mica .08

#14 D.C.C. Magnet wire .64

1 Sheet fibre bending wire .02

.02

.76

Labor 4.65

$5.41

Nature of trouble

B.O. arm coil.

S.C in com

LABOR

Mechanic Clark 8½ hrs .340

Helper Fisk 5 hrs .125

$4.65

Checked OK Stevens. JUN 12 Fil'd

Fig. 2. Shop Repair Ticket

In most plants the driving motors are worked well up to their capacity (in some cases beyond that point) and upon their performance depends the daily output; each motor should be inspected daily for any showing of defects, loose connections, keeping the brush tension normal, oiling devices operating freely, the motor free from dust and dirt and the commutator free from oil which would soon penetrate the mica insulation and carbonize. The starting and the speed-controlling devices should also be given attention and all sliding contacts kept free from burrs or burns and must make proper contact.

To do this, allowing but a few minutes at each motor, and to have positive evidence that each motor is actually visited, a card form has been developed as shown in Fig.

*Chief Electrical Inspector, Operating Department, Edison Electric Illuminating Co. of Brooklyn.

1, having the numbers from 1 to 31 printed along one side and the bottom, to correspond to the days of the month. A card holder of tin, with the edges of the sides and bottom turned over to hold the card, is placed on or near each motor; several ticket punches, each having a different design, are required, one for each inspector.

MOTOR SHOP No. 106 SERIAL
DEPT. Tool Room
Make G.E. HP. 3 RPM. 1250
Volts 220 Amp. 11 Type. C E Cl. or Form. A
Size of brush 5/16 x 1 1/4 x 3/8 Stock No. 39
Number brush studs 2 Per stud 2
Date received NOV 12 1911 Cost
Date in service JAN - 5 1912 Dept. Tool Room
Machine Crank Shaper Shop No. 54
Starter C-H Bull 10
Out of service
Disposition

FIG. 3. MOTOR INDEX CARD

Each morning as they start on their rounds the foreman distributes these punches, changing them each day to prevent the skipping of a motor one day and the punching of the card the next day. It is also well to change the routes of inspectors, not only to prevent possible collusion, but to better familiarize all of the men with the entire factory equipment. The punch mark of each man for any certain day will appear on the motor-inspection card on that date for each motor that he visits, and on his time card for that date also. This gives an absolute check on the movements of each man for every day he is on inspection duty.

These cards are arranged for one month each, numbered according to the "shop number" of each motor, the cards being turned in on the last day of each month and new cards placed in the holders on the trip made the following day; each card contains the complete record of that motor bearing the same shop number. If repairs are needed, the inspector so notes on the card and immediately informs the foreman who assigns a repair man to do the necessary work.

Should it be necessary to stop the motor, the time of stoppage is noted on the card together with a brief statement of the cause of the trouble. If material is required for the job, he makes out a "Shop Repair Ticket" (Fig. 2), which also serves as an order for the material at the storeroom. The total time spent on the job is noted on the ticket, which is turned in to the storekeeper at the completion of the work and the prices of all material used filled in and the ticket placed in the "Inspection Box." The ticket is removed from the box by the foreman or assistant, the work inspected and tested and the card returned to the foreman's desk, where items and time are checked and entered and the card filed, after the repair costs also have been entered on the back of the "Motor Index Card" (Fig. 3).

With these three forms, used in conjunction with the workman's daily time sheet such as is commonly used in all industrial plants, an absolutely accurate record is instantly available for reference and at the end of each quarter or year, the maintenance costs for the period can quickly be figured.

The motor-index card contains all data pertaining to the motor bearing that "Shop Number," each motor being assigned a number which is painted or stenciled on the frame as soon as received and a card filed in the index to correspond. These forms are printed on standard 3x5-in. cards and filed in numerical order, or by departments as desired. The shop-repair ticket forms are printed on 4x6-in. manilla cards as are the "Motor Maintenance Records," the former also being used for repairs to any machine or other shop equipment in the plant and filed according to number in a separate filing box under "Shop Equipment."

Brushes and brush troubles are a large factor in smooth operation; when new brushes are placed on a motor, the old ones should be turned in to the storekeeper, not necessarily for further use, but as evidence that new ones were actually required. In some cases the unused portion can be cut down for smaller motors, thus effecting a saving.

Care in the selection of brushes should be exercised, and it will be found cheapest in the end to buy the best brush obtainable, as cheap grades of carbon brushes usually contain more or less grit which is bound to cut

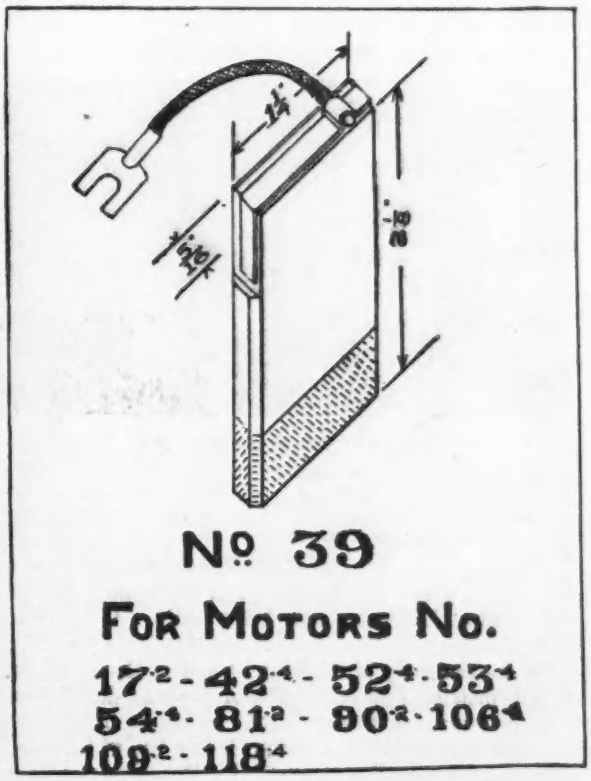


FIG. 4. PRINT OF THE BRUSH REQUIRED FOR CERTAIN MOTORS

the commutators and prevent their acquiring a glazed surface, as they should under proper selection and care. Brushes should be standardized and each separate size used given a "Stock Number" and prints made showing in exact sizes, all brushes used. These prints will not only be found to be a great aid in keeping down mistakes in the shop, but when a new supply is required, a print of

the brush with the order insures the receipt of the proper brush. Upon each print, under the stock number, should appear, "For motors No. ....., followed by the shop number of each motor requiring that particular brush (Fig. 4). The small figure to the right of each motor number, is the number of brushes required for that motor.

Should there be any question regarding the exact brush required on any motor, reference to the brush prints quickly disposes of the matter. This system is also applicable to those firms who carry on a motor-inspection and maintenance business, by merely substituting "Firm" or "Location" in place of "Department" on the cards. Electrotype plates of the forms can be procured at a low cost and will reduce the printing bills to a considerable extent. The system has proven beyond any doubt that it is a time-, labor- and money-saving proposition.

The South San Joaquin Irrigation Project, California

A large irrigation project was put under construction in 1911 by the South San Joaquin Irrigation District, California. Edwin Duryea, Jr., of San Francisco, is chief engineer for the district and to him we are indebted for the following outline of the nature and present status of the project.

Fig. 1. View from Below

Fig. 2. Looking across Dam from North End

Figs. 1 and 2. Goodwin Diversion Dam, South San Joaquin Irrigation District, California

The district comprises 71,050 acres of nearly level land, of a sandy-loam character and practically all irrigable under the system now being built. About 3000 acres of this area have been irrigated for some years.

The water-supply of this district and of the adjoining Oakdale district is the entire flow of the Stanislaus River. The water is taken from the river by means of a diversion dam and headworks (Figs. 1 and 2), which were completed early in December, 1912. The diversion dam is of a pure arch type, with two 135-ft. radius spans abutting on a central pier, making a total crest length of 466 ft. The maximum height of the dam is 78 ft., or 70 ft. above the intersection of its lower side with bedrock. The maximum thickness is 16 ft. at the point just named, which is at Elev. 280 ft. From here until downstream low water (Elev. 289) is reached (which will be maintained by a low dam a little ways below the main dam) the thickness diminishes rapidly to 12 ft., then slowly to 8 ft. at Elev. 325 ft. (high water of Jan. 31, 1911; but in March, 1907, high water was at Elev. 334 ft.). For the remainder of the height the dam is perpendicular on each face and 8 ft. thick, except that in the upper 3 or 4 ft. there is an overhang on the downstream side and the upstream side is chamfered off. The crest is at Elev. 350. The structure is known as the Goodwin Dam.

The headworks consist of a double set of cast-iron gates in concrete regulating works.

The main canal has a length of 19 miles, with shapes and sizes depending on the character of rock, the surface slopes and the ability of the material to resist erosion. About 3½ miles of the main canal were entirely completed by the end of March, 1913. The remaining 15 miles are now practically completed, and on Aug. 13 water through the main canal arrived at the upper edge of the Irrigation District.

The distribution system has been very carefully designed so as to deliver a head of 16⅔ cu.ft. per sec. at the high point of every Government 40 acres within the District. When completed it will comprise about 360 miles of irrigation canals and ditches and some 35 miles of drainage canals. The contract for the main distributary canal, 12 miles in length, is now under way and nearly completed and a contract for about 20 concrete structures (headworks for branch canals, etc.) along it is in progress. Contracts for all of the remainder of the 360 miles of canals and ditches are also under way, and a contract has been let for about 2,500,000 ft. b.m. of lumber for the wooden structures along them.

A storage reservoir is to be situated about seven miles east of the east edge of the District. It will be formed by inclosing a small foothill valley with a dam about three miles long and filled by the supply canal that enters the upper end of the valley. A capacity of 49,000 acre-feet is proposed for the present, to be later increased by raising the dam 15 ft., developing in all 101,000 acre-feet. If desired in the future, a second dam (several miles above) will increase the total storage to 134,000 acre-feet.

The total cost of the system will be about $3,835,000 in irrigation-district bonds, or at the rate of $54 in bonds per acre. Of this the diversion dam and headworks and the supply system will have cost about $27 per acre, the distribution system about $16 per acre and the reservoir storage (for 49,000 acre-feet) about $11 per acre.

The total cost given above is now about half expended and the work of completing the system is being carried along as rapidly as practicable, so that it may be completed (except the storage reservoir) by April, 1914.

The Brick Roads of Cuyahoga Co., Ohio*

By James M. McCleary†

SYNOPSIS—The brick-paved country roads which have been built during the past five years in the territory surrounding Cleveland, Ohio, especially in Cuyahoga County, have received high praise from engineers and road builders; but in many cases where brick pavement has been adopted for roads and streets in other localities, nothing like as good a road has been secured. The following paper by the engineer in charge of the construction on these famous brick roads makes clear that success depends on faithful care in a number of small details of construction. It may be difficult for an engineer to induce the average street-paving contractor inexperienced in brick paving to work in this painstaking way; but the Cleveland results show that it is just this care and skill, which is essential to success. Mr. McCleary's paper deserves the careful study of every engineer interested in road and pavement construction.

The road system of Cuyahoga County has received so much praise that anyone who claims connection with its development incurs danger of the charge of egotism, provided he omits to point out that the much heralded excellence was a gradual growth and that costly mistakes marred the county's early ventures into this realm of improvement. These mistakes were less due to wrong theories or practices of the engineers than to the demand of the taxpayer for a cheap improvement.

I shall deal with the mistakes of early brick construction, for it was by these earlier experiences that the present methods of building brick roads in Cuyahoga County were evolved. No peculiarities of topography or soil make this kind of road more appropriate in Cuyahoga County than elsewhere. In the western part of the county the land is so level that drainage is a difficult problem and must be given much consideration. In the southern and eastern parts, the land is so broken that to secure a feasible grade without undue expense for excavation becomes the chief difficulty. The soil varies from a sticky yellow clay in the southern and eastern sections to a sandy loam at the west. The development of the brick road in Cuyahoga County, therefore, was obstructed by all the possible problems to be found elsewhere.

The first brick road in Cuyahoga County was started in 1893 and completed in 1895 and located on what is known as the Wooster Pike in the southwest portion of the county. The wearing surface was of standard size brick, 8 ft. in width, tar filled, placed between stone curbs, 3x15 in. and resting upon a 6-in. broken stone base. The pavement was placed upon one side of the roadway with a graded earth drive occupying the balance of the width. No drainage was provided and really nothing of detail was taken into consideration. The specifications were principally contained in the title on the back of their cover. So far as the contract was concerned, it provided chiefly that the contractor was to be paid in any event. If anything could open the eyes of blind justice, surely it would be this first contract awarded in Cuyahoga County for brick pavement.

No requirement in the specification dealt with the quality of the stone and the result was that the contractor gathered up field stone for his base and they were of such consistency that, when the roller had done its work, one might think that sand ballast had been used. Upon this the cushion was placed without compression and then the brick. As to the filler, no one could have told its composition at the end of six years, so little of it could be found.

The pavement being but 8 ft. in width, all of the traffic came in one place. Lack of bond and absence of uniform support caused a depression to appear. In the wet season, this rut or groove filled with water which soaked through the base, creating a worse condition from day to day during the damp seasons. The colder weather brought upheavals and such havoc that many sections of the improvement (so called) were a hindrance rather than an aid to the traffic.

I anticipate your query as to why these defects were not repaired. Strange as it may seem, the law under which these improvements were made permitted no expenditure for maintenance. In 1898 this legislative flaw was remedied, but for five years there was no chance to palliate the badness of our methods nor to interfere with the increasing dilapidation which constituted the chief value of this road—the value of a horrible example.

The next road laid was South Woodland. Again the wearing surface was 8 ft. in width, tar filled and placed between flush stone curbs on a 6-in. broken stone base. We had learned, in a small way, from our first mistakes and placed a 6-in. drainage tile beneath the center of the roadway. But on account of the soft filler and imperfect preparation for carrying off the water, but little improvement in the result was realized. An uneven settlement of the base soon resulted in roughness. For all of its shortcomings, however, I wish to state that when it was taken up three years ago to be replaced by a 30-ft. roadway, its condition was such that by contrast, not every town or county could point a finger of scorn at it.

Lorain Road, our next installation, was built 16 feet wide, tar filled and resting upon a crushed stone and slag base between flush curbs, with drain tile beneath each curb. Subjected to an unusually heavy traffic, the almost inevitable result of such construction must be extensive repairs amounting almost to reconstruction.

Our next great forward step occurred when the tar filler gave way to a grout filler composed of one part sand and one part cement. This plan was followed until 1905 with success, at least in comparison with previous experiences. The cement filler alone, however, could not cure all of the defects due to inferior drainage and frost action. Another step was therefore decided upon, the inclusion in the specifications of a requirement for a 4-in. concrete foundation which, of course, increased the price. State Road No. 2 was constructed under this plan, the increased cost brought immediate opposition, resulting in a temporary return to a broken stone or slag base until 1908 when concrete was again adopted as a foundation and has continued up to the present time.

Since 1908 it has been the policy not merely to conform to the chief essentials of brick paving, namely.

The properly prepared subfoundation,
The smoothly finished concrete base,
The compressed sand cushion,
The laying of good brick,

The application of the cement filler to the joints, but to attach importance to minor details of approved manner and method of construction as will produce a road nearly approaching the ideal. Our approach to the ideal has given to us roads which have received almost a world wide commendation and have given to Cuyahoga County the best road improved district of any like sized area in the world.

A satisfactory plan for an average rural pavement may include a paved portion anywhere from 9 to 16 ft. in width, the width being controlled by the amount of traffic to which the road is subjected. A dirt or gravel macadam should occupy the balance or unpaved portion of width. Whatever dimensions are adopted, the surface drainage should be over the pavement toward a ditch on the side of the road closest to the pavement, eliminating a crown from the paved portion. The unpaved portion should be drained in the opposite direction.

Immediately you ask "Why a dirt road?" The best answer is, "Ask the farmer" and he will tell you to ask the horse.

The engineer will save himself much trouble if he holds to such a grade line as will entail minimum depths of fill. This is not always possible and it is the larger fills that call for the most extreme care. It behooves the engineer to see that his specifications contain a clause calling for the fill to be put in layers of not more than 6 in. thickness and each layer compacted with a roller, not exceeding ten tons in weight. This clause must be enforced with rigidity.

Puddling is the one method that can be followed successfully in the treatment of old fills. The surface of the road should be broken and dirt removed from the center to the sides. At right angles to this trench, shorter trenches should be dug at intervals of 25 ft. forming a rectangular vat. Pump water into these compartments and allow it to stand until it has leaked its way into the fill. This will disclose the weak spots and the engineer can take care of them as he thinks best.

The drainage of the graded portion of the road is of first necessity. Whatever plan is adopted, the one that will

*Paper presented before the American Road Congress, Detroit, Mich., Sept. 29-Oct. 4, 1913.

†Road Engineer, Cuyahoga County, Ohio.

most nearly maintain the sub-structure free from moisture below the frost line is the ideal condition to be sought. This means that you must not merely drain the road bed, but adequate side ditches must be provided to carry off promptly the accumulated water.

In the preparation of a sub-base the only debatable proposition is the purpose of rolling. Common practice, including the use of a very heavy roller, has been founded upon the theory of compacting the soil to as great a depth as possible. This can do no harm but I am personally inclined to believe that the chief purpose of rolling is accomplished when the weak or spotty places in the soil are revealed, so that the engineer can treat them as he sees fit. For this purpose, a roller weighing from eight to ten tons answers every requirement.

Preceding the final preparation of the sub-base the curbs must be placed. In case of most of our rural work, curbs are placed flush with the surface of the completed pavement.

With curb set and base prepared the next step is the placing of the concrete base, which with our roads has been 4 in. in depth. In specifying the proportions, a mixture of 1:3:5 with a permissible variation according to the size of the aggregates which will most nearly fill the voids, meets every necessity. To meet this variableness, it is necessary to specify the size of your coarse aggregate, but not the amount, requiring only so much of the coarse aggregate to be used as shall leave the concrete most nearly free from voids. This, instead of an inflexibile rule of proportions, will relieve you of many arguments and will assure you a condition of concrete whereby a smooth surface is easily attained. A smooth surface you must have, for upon that much both of efficiency and durableness of your wearing surface depends. It enables you to accomplish in the next step a requirement of equal importance, that of placing the sand cushion of uniform fill and of uniform density.

While personally I do not place as much importance as some people do in the ability of the sand cushion to afford resilience or absorb the shock effect, it is unquestionably a necessity for the purpose of bringing the wearing surface of the brick to a perfect plane, by neutralizing the unevenness and lack of uniformity of the brick.

No one will question but that the support of the wearing surface provided for by this sand cushion must be uniform. It is therefore necessary to compress and bring to a like density every part of this cushion. Dropping the sand cushion onto the base from dump wagons and leaving the bottom portion of the load untouched before striking off with a template is objectionable and renders the hand rolling difficult by having a dense pile and a loose pile to contend with, the roller spanning the looser portion. It is better to spread the sand entirely by shovels, then by rolling and striking off and re-rolling, even a third time. Thus you bring the cushion to an even density that not only will furnish an even support to the entire pavement, but will prevent the sand from flowing up into the joints of the brick when the brick surface is rolled. While it is not necessary for this cushion sand to be entirely free from soil and vegetable matter, it should be nearly so, otherwise its density cannot be maintained.

It is needless to go into the specifications for the brick further than to insist on lugs on the side, and grooves on the end of the brick. I do not mean that there should be no specification for the brick but that it is the place of the engineer to determine by the class of traffic in prospect, what percentage of loss shall be tolerated as a maximum in the latter test.

Granting that you are satisfied with your brick, their laying is the next proposition. First, see that the lugs are turned one way. Second, make certain that the joints are broken so that one third or more of the brick of one course overlaps the brick of the next course. Third, be sure that every fourth course is driven up to a straight line. Fourth, for the sake of appearance, keep the line of the brick at right angles with the curb.

Next in order is culling. Care should be taken to see that all soft brick or brick that are burned too hard are removed. Those so heavily kiln-marked that they will cause unevenness in the pavement should be turned. Caution should be exercised in this, for many a kiln-marked brick is thrown out which, if allowed to remain would have been of more value to the pavement than others that are retained.

After the brick are thus placed in the street, their slight unevenness should be ironed out by the use of a roller not exceeding five tons in weight. If a horse roller is used at all, it should have a diameter of at least 5 ft. Rolling should begin on one side and pursue a course parallel to the curb. The roller should return over the same course. The next trip should lap the first, the roller again returning over the same course. This should continue until the center of the pavement has been reached when the roller should be turned to the opposite curb and continue as before until the center is reached from the other side.

The roller should then start at one side and work diagonally across the pavement. This diagonal rolling will have a tendency to bed the brick in such a manner as to avoid "rockers." The pavement should then be culled again for broken brick after which it should be hand rammed with a paver rammer weighing not less than 50 lb. Interpose a plank not less than 6 ft. long, 10 in. wide and 2 in. thick, between the surface of the pavement and the rammer. The plank should be laid parallel to the curb.

For filling joints, the next process in order, use a grout filler composed of equal parts of sand and cement. It seems hardly necessary to state that the cement should meet the standard specifications for portland cement as adopted by the American Society for Testing Materials. The sand with which we have had much success has been taken from the lake and although not very sharp is nevertheless fine and clean and has given such good results that I cannot do otherwise than recommend its use. In any event the sand to be used should be free from sewage, acid or soil, and should be sharp and fine.

A watertight box, standing on uneven legs so as to afford a "lower corner" should be used as a receptacle for the grout. In it place not to exceed one cubic foot of sand and one bag of cement, mixing the mass until it assumes a uniform color. Add water and stir the mixture until it assumes the consistency of thin cream. The mixture should then be applied to the pavement by means of scoop shovels and thoroughly swept into the joints. After this has had sufficient time for setting, a second coat, slightly thicker should be applied and later a third coat which will assure filled joints. This last coat should be worked either with a specially prepared broom or a rubber squeegee and swept across the joints at an angle of 45°.

After the initial set has taken place, the pavement should be covered with a half inch or more of sand and this should be kept saturated with water for at least five days. The pavement should not be opened to traffic for at least ten days.

We have not undertaken any special provision against possible thermal effect, such as contraction and expansion due to low and high temperatures, but have relied mainly upon the condition of our structure by avoiding moisture underneath the roadway, and by an endeavor to have our cement-filler at the greatest possible strength. These provisions, together with a rigid curb, enable us to hold in compression the expansion occurring in our narrow roadways. In this respect, we have not been entirely successful. A few cracks in the pavement have appeared, but so far, they have not raveled out so as to injure the traffic worth of the road and have not been thought of sufficient importance to require repairs.

In trying to express the proven worth of such roads to the community, I am at a loss for words. Their economy has been proven in contrast with any other methods of road building from the cheapest to the most expensive. I make this statement after comparing the annual maintenance cost of other types of good road with the utter lack of any repair expense, on brick roads, due to ordinary wear. Our only repair expense has been caused by early mistakes in construction.

The fact that our roads are in shape for maximum service twelve months in the year and that they originate no dust has endeared them to abutting dwellers and to travelers from a distance. Washing by rain suffices to keep them clean and imparts a sanitary advantage which has been much emphasized by health authorities.

Perhaps the most eloquent praise is contained in the simple statement that, although we have built nearly 400 miles of such road, 33 farmers' petitions are now on file in our office, asking for 33 separate extensions. Local sentiment may be conservative, but it everlastingly catches on when it is shown something really good. We are no longer besought to make cheap roads, but to make good ones. Witness one case where assessments on a macadam road had still four years to run and yet so eager were the abutting owners for a better road that they threw four years payments into the discard and signed unanimous petition for brick. The petition was granted and brick laid, although it was necessary to scrap a relatively new macadam road to do so.

In a day when power traffic is imposing new tests upon road surfaces, and when the aggregate of all traffic is increasing so rapidly, I cannot avoid the feeling that we were fortunate in wasting little time and expense upon methods that could bring us no ultimate advantage. Our early ex-

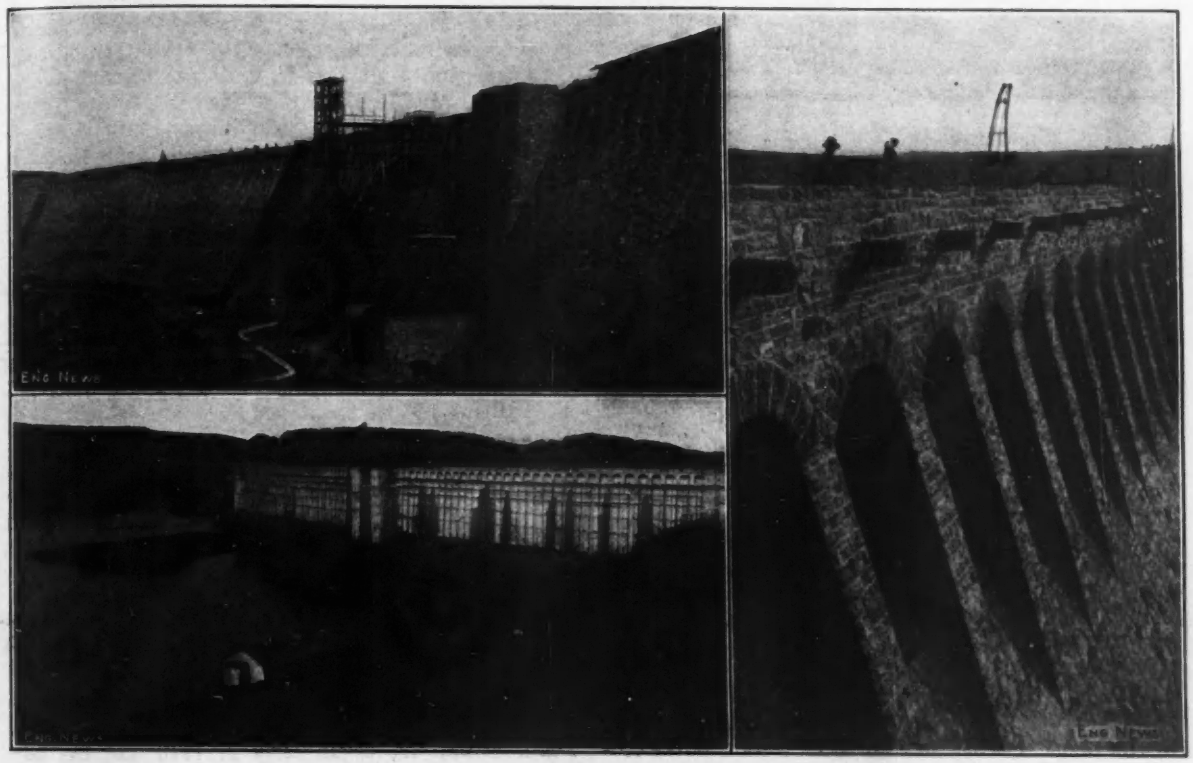
pervients were often far from successful but they carried us along a course of evolution to something better than we could possibly anticipate. We must credit good luck alone for the fact that our venture dealt with a type of road peculiarly adapted to forms of traffic which could not be foreseen in 1893 when the experiments commenced. We can only claim credit for persistence in building year after year without a single omission for two decades, in refusing to be discouraged by failures and in availing ourselves of the only chance that any man can ask—the chance to correct his own mistakes.

The Möhne Dam, Ruhr District, Germany

The most recent of Germany's large series of water-storage dams to be completed is shown in the three photographic views reproduced herewith. From data concerning the structure sent us by Dr. A. Gradenwitz, Berlin, we give the following.

The drainage area above the dam is about 160 sq.mi. It is estimated that the Möhne reservoir can store 53% of the total annual runoff from this area. Since the purpose of the work is equalizing the flow, the water stored in the reservoir being all discharged into the valley below, it is possible to utilize the water power created by the reservoir. For this purpose a power house is built just below the dam, in which are installed four turbine-generator units of 1600 hp. each.

The dam is 131 ft. in maximum height, and its cross-section is 112 ft. wide at the base. The crest roadway is 20 ft. wide. In plan, the dam is arched slightly upstream; its total length is 2100 ft. The structure is of stone, laid in cement. The water side is faced with two waterproofing coatings of lime-cement-trass mixture with a slight asphalt-emulsion addition; the waterproofing is protected by brick facing. The interior of the dam has drain wells through it at intervals, to discharge into the valley below any water infiltrating through the masonry.



THREE VIEWS OF THE MÖHNE DAM, RUHR DISTRICT, GERMANY
(Downstream face; upstream face, with construction staging; near view of crest masonry.)

The dam is located at the mouth of the Heve River, a confluent of the Möhne, the latter in turn being tributary to the Ruhr. The Ruhr Valley is the center of the great iron, coal and manufacturing district west of Düsseldorf, and the water of the Ruhr is utilized at many points. Extreme low-water periods of the Ruhr, which in occasional instances are so extreme that no runoff from the Ruhr reaches the Rhine, are therefore felt as a very severe hardship to the Ruhr region. Eight or ten years ago a conservation district was formed in the Ruhr Valley for the purpose of erecting storage dams to equalize the year's flow. The Möhne Dam is the largest of the storage works erected for this purpose, the reservoir behind it having a capacity of 4600 million cu.ft. and the total cost of the dam and auxiliary works being about $5,000,000.

The dam was built by D. Liesenhoff, of Dortmund, contractor.

Famous English Contracting Firm To Dissolve—After 65 years of existence the firm of John Aird & Co., of London, England, is to be dissolved, although the retirement of the firm from business will be gradual and dependent upon the completion of contracts at present under way. Probably the most famous of the firm's work was the building of the Assuan dam across the River Nile in Egypt. The firm was founded by John Aird, a Ross-shire man, who left the service of a Greenwich gas company in order to embark in the business of laying gas and water mains in the city of London. The late Sir John Aird, son of the founder of the firm, assumed charge of important work when only 18 years of age.

Camp Hill View Sanitation, Catskill Aqueduct

By Arthur W. Tidd*

Throughout the entire length of the Catskill Aqueduct, from the Ashokan Reservoir in the Catskill Mountains to New York City, approximately 120 miles, a sanitary supervision is exercised by the Board of Water Supply over the housing and living of the laborers employed on their work and the disposal of all wastes. The specifications for each contract require the contractor to provide for proper sanitation and in many cases specify just what these provisions shall be.

Historical—These wholesome sanitary provisions in connection with the building of this new, 500 million gallons daily water system mark another step forward in the improvement of the sanitary conditions of construction camps. The first definite action along this line with which the author is familiar was taken by the Metropolitan Water Board of Boston, Mass., when in 1895 preparations were under way for constructing the Wachu-

Fig. 1. Camp Hill View, Catskill Aqueduct

sett Reservoir and Wachusett Aqueduct.† In the early specifications for this work the contractor was "to adopt and enforce promptly and fully such sanitary regulations in regard to the construction and maintenance of privies for his men, or arrangement of his shanties, as may be directed by the engineer." Other clauses were added from year to year as new specifications were written. In 1905 the city of Pittsburgh, Penn., embodied clauses in the specifications for its filtration works covering medical examinations, supervision of the housing of the men, and the disposal of all wastes in accordance with sanitary principles. The Cross River Dam and Reservoir, built by the Croton Aqueduct Commission of New York City, was being designed at about the same time, and those specifications are quite similar to the Pittsburgh ones. The early contracts on the Board of Water Supply work were quite similar to the Cross River specifications in this respect. When, however, in 1908, preparations were being made for the construction of the Catskill Aqueduct through the Croton watershed and from there south to New York City, the subject of the sanitary control was taken up afresh by the engineers of the Board and considered with great thoroughness. In some of the contracts the precautionary measures were so extensive and the sanitary clauses so rigidly drawn that a specific payment item was provided in the contract for the sanitary service and payment was also provided under other appropriate items for the construction of such special structures as were ordered.*

In 1909 the Board of Water Supply engaged Dr. Ernst J. Lederle as Sanitary Expert. His duties were to consist in:

> **Supervising all sanitary matters in connection with the work of the Board, the preparations of all plans and specifications in relation to such matters to accompany or to be embodied in the contracts to be prepared by the Board of Water Supply, and devising and promulgating all proper rules and regulations in reference to such matters, including rules and regulations for the care and health of the employees of this Board, and of the contractors having contracts with the Board, for the erection and maintenance of camps and hospitals and the proper inspection and supervision of the operations under said contracts, with reports from time to time, and as often as may be necessary, or required, to the Chief Engineer of the Board in regard to such matters.**

Dr. Lederle resigned in January, 1910, to become Commissioner of Health of New York City, and the Board appointed Herbert D. Pease, M. D., and Andrew J. Provost, Jr., C. E., both of New York City, to succeed him. Dr. Pease and Mr. Provost, with Dr. David S. Flynn as their representative in the field, have continued to date in charge of this branch of the Board's work. As a part of their duties all camp sites and all plans for the camp layout are subject to their approval. Proper provisions must be made for a potable and ample water-supply, for a proper sewerage system and for safeguarding the health of others in the vicinity. The most extensive and rigidly enforced precautions are taken when work is being conducted within the limits of a watershed which is tributary to a public water-supply. Plans for all camp buildings are submitted for their approval before beginning work on the contract itself. And all through the life of the contract, as will be described later, a most thorough and continual inspection and supervision is maintained over all matters allied in a sanitary way to the contract and the laborers.

This paper describes the camp and the sanitary measures in operation in "Camp Hill View," the camp established in connection with Contract 30 for the construction of the Hill View Reservoir. The estimated value of this contract is $3,269,000 and the time for completion is 6 years and 4 months. The contractor is the Keystone State Construction Co., of Philadelphia, Penn. Work was begun early in 1910 and has been actively prosecuted since that date.

General Description—The camp is located on nine acres of leased land adjoining the site purchased by the city for the Hill View Reservoir (see maps in Fig. 2). It lies within the limits of the City of Yonkers, just north of the northern limit of New York City and about midway between the City of Yonkers and the City of Mount Vernon. The locality is fairly well built up with houses of moderate rent, occupied by people employed in Yonkers, Mount Vernon and New York. Street railroads are operated throughout the district in all directions. There is no sewerage system but all other city conveniences have been provided. The reservoir is located at the southern extremity of a high, narrow ridge of

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†At that time Nashua Reservoir and Nashua Aqueduct.

*For a more complete history of the evolution of these sanitary specifications, see the discussion of the paper, "The Sanitation of Contractors' Camps and the Patrol of Watersheds," A. J. Provost, Jr., author, by T. H. Wiggin and Morris Knowles, Jour. Assoc. Eng. Soc., June, 1912.

glacial origin extending in a northerly direction. The site selected for the camp slopes gently to the east, draining into a small water course about two hundred feet away, a tributary of the Bronx River. A large expenditure was necessary to clear the site of underbrush and boulders, to build blind drains for lowering the water table and ditches to care for the surface drainage.

posal and a large Woodruff pit for destroying garbage and general camp rubbish. The buildings and surrounding spaces are lighted by electricity from sunset to sunrise. The commissary, hospital and power house are connected by telephone. The buildings are well-built, wooden-frame structures, those for habitation being set on posts well above the ground. They are constructed

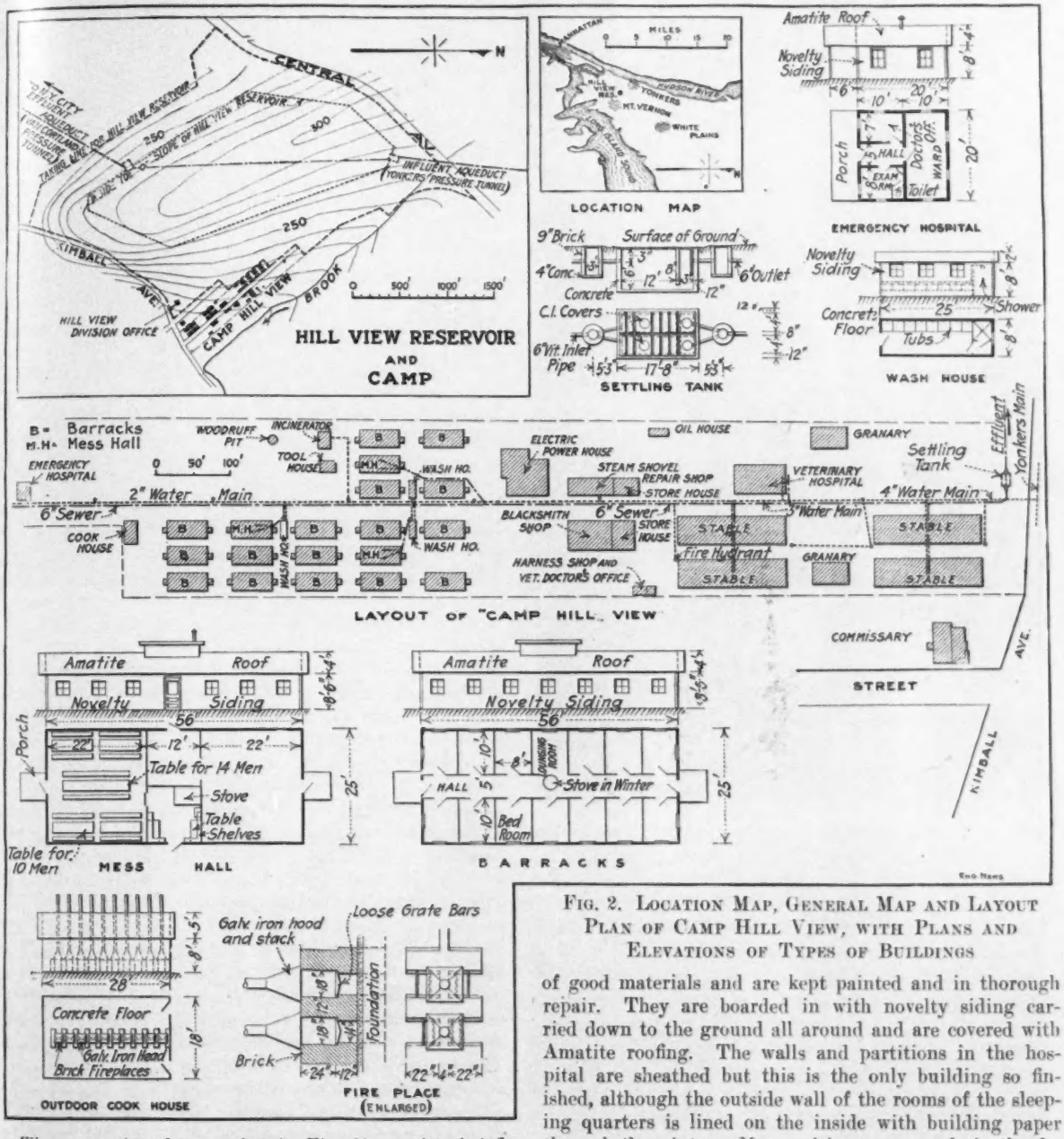


FIG. 2. LOCATION MAP, GENERAL MAP AND LAYOUT PLAN OF CAMP HILL VIEW, WITH PLANS AND ELEVATIONS OF TYPES OF BUILDINGS

The camp (see layout plan in Fig. 2) consists briefly of 16 barracks or sleeping quarters, 3 mess halls, a commissary, an emergency hospital, an outdoor cook house, an incinerating plant, 3 washhouses, 4 stables, a veterinary hospital, 2 granaries, 3 shops and a power house for generating electricity, all systematically arranged along a central street. It has a water-supply connected with the City of Yonkers system, hydrants for fire protection, a sewerage system with a settling tank for dis-

of good materials and are kept painted and in thorough repair. They are boarded in with novelty siding carried down to the ground all around and are covered with Amatite roofing. The walls and partitions in the hospital are sheathed but this is the only building so finished, although the outside wall of the rooms of the sleeping quarters is lined on the inside with building paper through the winter. No provisions were made in the design of the camp for accommodating men with families and with the exception of one instance where a family lived in a tent for a portion of one summer and in a few others where a man and his wife ran one of the mess halls, no women have been in the camp. No separate houses were built and none are allowed to be built by the men. No trouble has been experienced by those having families in finding suitable houses in the vicinity of the

work. All persons in camp are obliged to sleep in the barracks.

Sleeping Quarters—The sleeping quarters or barracks (shown as part of Fig. 2) are all alike, 25x56 ft. in plan, 12½ ft. to the ridge with a 12-ft. louver. The rooms are 8x10 ft., arranged along a central hall running the length of the building. They are built tight to a height of 8 ft. and above that the partitions between the rooms and along the hall are latticed to the roof, providing thorough ventilation. There are 7 rooms on one side and 6 on the other, one room in the center being used for a general lounging room. A large coal stove similar to the familiar station heater is set up in the hall at this point during the winter; it is the only

Fig. 3. Laborers' Sleeping Room, Camp Hill View Barracks

means provided for heating the building and is sufficient for the purpose. The exposed wall of each room is covered on the inside with building paper through the winter. Each room (Fig. 3) has a door and a 3x3-ft. sliding window. At each end of the hall is a panel door, the upper half glazed, and in the summer screen doors are added. All windows have fixed wire screens through the summer and the louver is screened. Two men are allowed to occupy a room together, two separate iron spring cots with mattress being furnished with each room. Each room contains over 800 cu.ft. of air space without counting the free ventilation into the hallway. No cooking is allowed in the building. The barracks are swept out daily and the sweepings taken to the Woodruff pit. No objections to the two-men rooms were ever raised by the men; in fact they seem to prefer them. The rooms have a decided effect on the successful maintenance of generally orderly conditions inside the buildings.

Mess Halls—The mess halls (Figs. 2 and 3) are alike, 25x56 ft. in plan, 12½ ft. to the ridge and open to the roof. Each building is divided into two separate establishments, each consisting of a kitchen and dining room, by a partition tight from floor to roof and with no means of passing from one establishment into the other. The building has a louver similar to those on the barracks. Each dining room is equipped with 5 wooden tables and benches capable of seating 54 men. The tables are covered with oil cloth. Each kitchen is provided with a coal range, a sink with a drain connected with the sewer, two tables and several rows of shelving. There is no running water in the building and water is obtained from the wash houses or taps near-by. There are many sliding windows and an outside door to each dining room and each kitchen. Screen doors are provided and all windows and louvers are covered with fixed-wire screens through the summer. Each mess hall is run by two men or by a man and his wife. The rooms are regularly washed and swept and kept in a neat and orderly condition.

Wash Houses—The wash houses (Fig. 2) are 8x25 ft. in plan and 10 ft. to the ridge; 4½ ft. at one end is partitioned off for a shower bath. A zinc-lined wooden wash trough about 2x2 ft., divided by zinc-covered partitions into 8 compartments, each with a faucet supplying running water, occupies one side of the remaining length of the building. The floor is concrete. The shower bath and trough are connected with the sewer.

Cook House—The outdoor cook house (Fig. 2) is 18x28 ft. in plan, 13 ft. to the ridge, the sides covered with corrugated sheet-iron and provided with two doors. There are 20 fireplaces arranged in two rows back to back, one galvanized-iron hood and smoke stack serving each pair. The fireplaces are built of brick. The floor is concrete. Ample provision is made for circulation and ventilation by leaving off the siding in each end in the peak and more openings are made in the summer. This cook house has not been entirely successful in eliminating the individual outdoor cook house or shack and the subject is taken up in detail later on in this paper.

Emergency Hospital—The hospital (Fig. 2) is provided and equipped for the proper treatment of all minor accidents and illnesses, arrangements being in force with hospitals in the vicinity to handle all serious cases. The building is 20x20 ft. in plan, 12 ft. to the peak, with a porch extending across the entire front. One-half is partitioned off for a ward and the other half is divided into an office about 6x9 ft. for the doctor, a 5-ft. hall leading to the ward and an examination room about 7x9 ft., containing a wash basin with running water and a toilet connected with a cesspool. The building is heated by a stove and is completely screened in the summer. The ward is supplied with iron-spring cots, mattresses and coverings, and the other rooms with the necessary cabinets for medicinal supplies, desks and chairs. The walls and partitions are sheathed.

Sanitary Conveniences—For the use of the laborers on the work some 15 or 20 pan closets, well built but light enough to be readily moved about as needed, are provided. A hinged ridge is used for a seat. The whole interior is open and can be readily cleaned. The pans are made of heavy galvanized iron, 15x18 in.x8 in. deep, one to each closet. For those in the camp, the four corners of the incinerator house are partitioned off into in-

dependent toilets, entered only from the outside, 2 for the men having 6 seats each and 2 for the women having 2 seats each. The galvanized-iron pans are used here also, being removed from the backs of the closets on the inside of the building. All persons are required to use these conveniences. The portable sanitaries are well taken care of and are not offensive. The seats and floor of the toilets in the incinerator house are thoroughly washed out with a hose daily. The pans on the work are collected daily by one man with a horse and light wagon. They are emptied into the furnace, washed on a washing platform in the rear of the incinerator house with a stream of water and turned upside down to dry. Chloride of lime is applied daily over the area affected by this washing.

FIG. 4. MESS HALL AT CAMP HILL VIEW, CATSKILL AQUEDUCT

INCINERATING FURNACE—The contents of the pans are incinerated daily in a large brick furnace of the grate-bar type, operated without water-tight ovens. A complete description of the construction and operation of this furnace was published in ENGINEERING NEWS Jan. 23, 1913. It was planned to increase the height of the stack in case the odors should become a nuisance when the furnace was in operation (from 6 to 12 hours daily) but it has never been considered to be necessary.

WOODRUFF PIT—All garbage, sweepings from the buildings, bottles, empty cans, papers and rubbish collected around the camp site, are burned in a large Woodruff pit. The pit (Fig. 5) is circular, about 13 ft. in diameter and 4 ft. deep, with vertical sides lined with field stone. The edge is flush with the surface of the ground. A brick cone about 9 ft. high and 5 ft. in diameter at the base, with a central flue and many openings near the bottom, is built in the center of the pit to furnish the draft and conserve the heat. There is usually enough combustible material in the sweepings and rubbish (which are collected daily) to keep a smouldering fire but kerosene is thrown in whenever there seems to be any need for it; perhaps a gallon per day would be a fair average. The pit works very satisfactorily and requires little attention. There is very little odor.

SINK WASTE SYSTEM AND DISPOSAL—A 6-in. vitrified pipe sewer runs the length of the camp, with connections from the mess halls, wash houses and watering troughs in the stables. No excrementitious matter is turned into the sewer. The watering troughs in the stables effect a very considerable dilution by delivering some 4000 to 5000 gal. daily of practically clean water into the system. The troughs are semi-circular in cross-section, 18 in. in diameter, and extend the length of each stable (140 ft.) between the stalls. They are filled about half-full and emptied morning and evening. The sink waste

FIG. 5. WOODRUFF PIT FOR BURNING GARBAGE AND RUBBISH, CAMP HILL VIEW

flows into a two-compartment settling tank (shown as a part of Fig. 2) about 10x17 ft. in plan and 9 ft. deep, each compartment having a baffle wall 3 ft. from the outlet extending to within 12 in. of the bottom. The effluent is drawn from a point 3 ft. below the level of the liquid in the tank by means of a 6-in. T, with an arm projecting downward, and is discharged into a small stream about 200 ft. away that empties into the Bronx River. By means of a manhole at each end of the tank either compartment can be thrown out of commission for inspection, cleaning or repairs. The entire system has given very satisfactory service.

WATER-SUPPLY—A main connected with the city of Yonkers system runs through the camp, supplying wash houses, stables, numerous valves, faucets and the hydrants for fire service. Yonkers water is also piped around the job to supply locomotives, steam shovels and the like. The water boys are required to use this water.

SANITARY CLAUSES OF THE CONTRACT—The clauses in Contract 30 relating specifically to the sanitary measures are given below complete. They form a component part of the regular specifications for the construction of the reservoir. In order to further emphasize them and lest a bidder should overlook or underestimate their importance, a special paragraph in italics is placed in the brief statement at the beginning of the book in the "Information for Bidders" stating that "The sanitary regulations and the provisions relating thereto are particularly called to the attention of intending bidders." These clauses follow:

Sec. 59. SANITARY PRECAUTIONS—The contractor and his employees shall prevent nuisances in and about the works; shall protect water-courses, reservoirs, wells and other sources of water-supply, public or private, from pollution, contamination or interference, and safeguard the public health, as may be directed from time to time by the constituted authorities of the state and city. The contractor shall summarily dismiss and shall not again engage, except with the written consent of the Engineer, any employee who violates this section.

Sec. 60 INSPECTION BY THE ENGINEER—The Engineer shall have the right, in order to determine whether the requirements of this contract as to sanitary matters are being complied with, to enter and inspect any building or any part of the work, and to cause any employee to be examined physically or medically or to be vaccinated or otherwise treated; also to inspect the drinking water and food supplied to the employees. The sanitary precautions, the care of the employees, the buildings, and all territory occupied by the contractor shall at all times be satisfactory to the Engineer. The contractor shall promptly and fully and in every particular, comply with all orders and regulations in regard to these matters, including all sanitary and medical rules and regulations which may have been or may be promulgated from time to time. And to this end and to properly preserve the peace, the Board of Water Supply Police shall have the right of access to the contractor's quarters.

Sec. 61. MEDICAL AND SURGICAL ATTENDANCE—The contractor shall retain the services of a sufficient number of acceptable qualified medical and surgical practitioners who shall have the care of his employees, shall inspect their dwellings, the stables and the sanitaries as often as required, and shall supply medical attendance and medicines to the employees whenever needed.

HOSPITAL AND AMBULANCE SERVICE—The contractor shall make satisfactory arrangements for hospital and ambulance service and shall provide on the work and maintain in satisfactory condition a small building for an emergency hospital, where injured or sick employees can be given temporary relief until the arrival of an ambulance. Such building shall be heated, ventilated and screened, and shall contain a suitable number of beds and proper articles for giving "First Aid to the Injured" and for relieving ordinary forms of illness.

Sec. 62. STABLES AND OTHER BUILDINGS—All buildings erected on the land of the city for housing, feeding or sanitary necessities of the men or for stables for the animals employed on the work shall be built only in accordance with approved drawings and specifications at designated places. All buildings occupied by employees shall be thoroughly screened to exclude mosquitoes and flies.

Sec. 63. MEDICAL SUPERVISION OF EMPLOYEES—The medical supervision of the contractor over his employees shall extend to the physical and medical examination of all applicants for employment, in order to prevent persons having communicable disease from becoming connected with the work, and the contractor shall employ only persons shown by such examination to be free from communicable diseases. Whenever in the opinion of the Engineer it is necessary for the protection of the public health or the health of the employees, the contractor shall remove any employee from the work to a hospital or shall permanently remove from the work any employee whose presence is believed to endanger the health of other persons.

Sec. 64. HEALTH REPORTS—Once each week or more frequently, if required, the contractor shall give the Engineer, in such detail as may be prescribed from time to time, a written report signed by the physician in regular attendance, setting forth clearly the health conditions of the buildings, of the grounds and of the employees. If any case of communicable disease be discovered or any case of doubtful diagnosis, it shall be reported at once to the Engineer by telephone or messenger and confirmed in writing.

Sec. 65. SANITARY CONVENIENCES AND DISPOSAL OF EXCRETA—Buildings for the sanitary necessities of all persons employed on the work, beginning with the first men employed for preliminary operations, shall be constructed and maintained by the contractor in the number, manner and places ordered. All persons connected with the work shall be obliged to use these conveniences under penalty of discharge. In addition to the above, closets having water-tight removable receptacles, shall be provided and properly cared for in the tunnels and elsewhere, whenever necessary for the prevention of nuisances. These receptacles shall not be allowed to overflow, but shall be removed without spilling, at required intervals, their contents at once treated as directed and then promptly taken to a designated place and there disposed of as ordered. If incinerators be used they shall be efficiently operated. The Contractor shall provide a sufficient number of acceptable attendants to keep all sanitaries in satisfactory condition, and compel employees to use them. The contractor shall rigorously prohibit the committing of nuisances in the completed or partially completed structures or upon the land of the city about the works or upon adjacent private property.

Sec. 66. CONTRACTOR TO BUILD SANITARY WORKS—The contractor shall build such disposal plants, sewers, drains and other structures, and shall do such other work not herein particularly specified, as may be necessary for carrying out the intent of the sanitary precautions of the contract.

Sec. 67.—GARBAGE DISPOSAL—Garbage, both liquid and solid, shall be promptly and satisfactorily removed from the buildings and immediately placed in approved tight receptacles of sufficient capacity for about one day's ordinary production. At least once in 24 hours all such garbage shall be incinerated or otherwise thoroughly and satisfactorily disposed of.

Sec. 68. DISPOSAL OF WASTE WATER AND STABLE DRAINAGE—All wash water from kitchens, laundries and other places and all drainage from stables shall be conveyed by satisfactory means to places directed, where such drainage shall be treated by the means ordered.

Sec. 70. SANITARY PRECAUTIONS TO BE SATISFACTORY—The sanitary precautions described in Sections 59 to 69, inclusive, shall at all times be satisfactory to the Engineer, to the Department of Health of the City of New York, and to the local and State Boards of Health. The Contractor shall promptly and fully comply with all orders and regulations in regard to these matters.

Sec. 71. NO DIRECT PAYMENT FOR CONTRACTOR'S PLANT NOR CONSTRUCTION OF SANITARY WORKS—For providing plant, tools and equipment and for furnishing, erecting and removing the construction plant, quarters for men, stables, sewage and garbage-disposal works, water-supply and other temporary works, the contractor shall receive no direct payment, but compensation for them shall be considered as having been included in the prices stipulated for the appropriate items.

Sec. 72. PAYMENT FOR SANITARY SERVICES AND MAINTENANCE OF SANITARY STRUCTURES—For furnishing the necessary professional services, labor, materials and other requisites for the care and maintenance of the sanitaries, the collection, disinfection and disposal of garbage, excreta and other wastes, maintenance and operation of sewers, sanitary drains and disposal works, removal of objectionable matter whenever ordered from any part of the works,

care of the health of employees and for all other services necessary for carrying out the provisions of Sections 59 to 70, and such rules and regulations as may be issued thereunder from time to time, the contractor shall receive in full compensation the price per month stipulated in Item 62.

Sec. 69, omitted, refers to the possible use of a blowoff to be built in connection with the reservoir, for waste waters.

The monthly payment under Sec. 72 is $400. The prices bid for this item by the various bidders on this contract were $400, $300, $300, $250, $500, $50, and $200; the $400 being that of the lowest total bid received (Keystone State Construction Co.) and the $200 that of the highest.

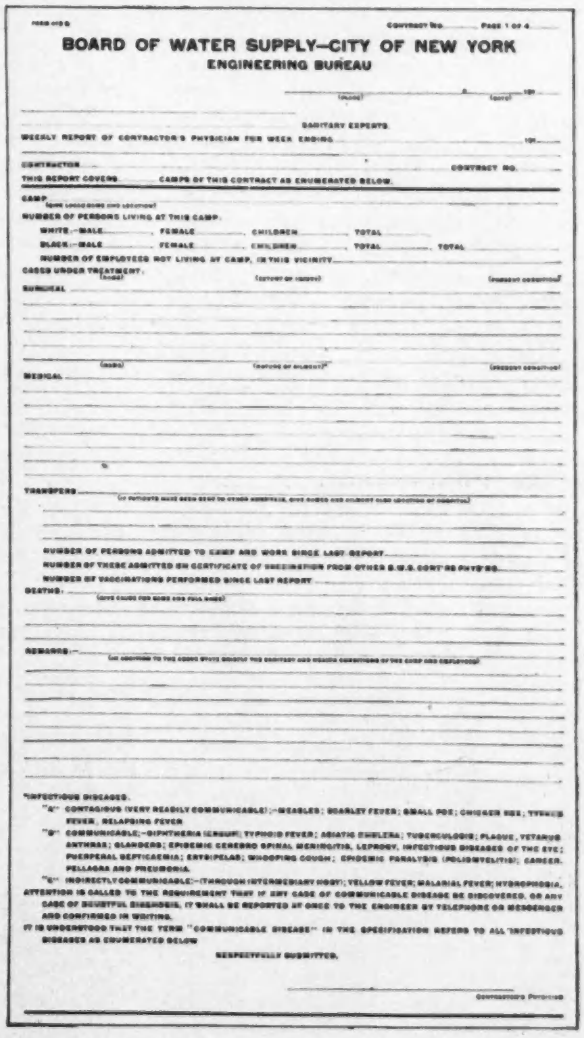
THE CARRYING OUT OF THE SANITARY MEASURES—This direct payment for sanitary services is new in contract work. It reimburses the contractor for his necessary expenditures in this direction and places him in a position to coöperate with the engineers in carrying out the sanitary clauses. This attitude was taken at the beginning of the work and has been admirably maintained. The plans for the buildings and all the details of the camp were submitted by Henry Delaplaine, chief engineer of the contractor, for the approval of the engineer and the sanitary experts of the board and they were carried out as approved.

The buildings are kept in repair and in a neat and orderly condition. The sleeping quarters are swept out daily and the refuse taken to the Woodruff pit. A man is detailed to the work of going through the camp daily gathering up papers, bottles, empty tins and miscellaneous refuse and rubbish. The pans from the closets around the work are collected daily by wagon by one man who also charges the incinerator, tends the fires and cleans and washes down the incinerator house and the toilets in the building. The mess halls are clean and wholesome. No garbage is allowed to accumulate and no wash water is allowed to be thrown out of doors or windows. The garbage is taken promptly to the Woodruff pit and cast in with the other refuse. The manure and bedding from the stables are carted away daily to farms or greenhouses. The urine in the stables is largely absorbed by the manure and bedding. Cesspools were designed to be used with each stable but they were never built and no annoyance has ever arisen from this source. The fact that the horses leave the stables in the morning and do not return to them until night accounts for the fact that there is a smaller amount of urine to be cared for here than in most stables.

A factor which contributes in no small degree to the excellent conditions that obtain in the camp is the Board of Water Supply Police. This branch of the Board's organization was organized pursuant to legislative requirement for the purpose of preserving the peace among the 16,000 laborers along the line of the aqueduct and for the protection of the communities from acts of violence and lawlessness. As a part of their duties a patrol is maintained, day and night, throughout the camp and vicinity and their presence alone tends to prevent many breaches of sanitary discipline. A few arrests are however found to be necessary each year in order to enforce compliance with the regulations.

MEDICAL SUPERVISION—Under the requirements of Sec. 61 of the contract and specifications, a suitably qualified medical practitioner was engaged by the contractor at the start of the work. This physician employs a doctor who is always at the emergency hospital or within easy call. Arrangements are in force with a hospital in the vicinity for ambulance service and for taking care of all serious cases.

A physical examination is made of all employees entering the camp or applying for work on the reservoir and the report of the examination is a factor in the acceptance by the contractor. Open cases of tuberculosis are rejected. Also an employee on the work may be removed if his presence is likely to endanger the health of others.



BOARD OF WATER SUPPLY—CITY OF NEW YORK
ENGINEERING BUREAU

SANITARY EXPERTS.

WEEKLY REPORT OF CONTRACTOR'S PHYSICIAN FOR WEEK ENDING

CONTRACTOR CONTRACT NO.

THIS REPORT COVERS CAMPS OF THIS CONTRACT AS ENUMERATED BELOW.

CAMP

NUMBER OF PERSONS LIVING AT THIS CAMP.

WHITE.—MALE FEMALE CHILDREN TOTAL

BLACK.—MALE FEMALE CHILDREN TOTAL TOTAL

NUMBER OF EMPLOYEES NOT LIVING AT CAMP, IN THIS VICINITY

CASES UNDER TREATMENT.

SURGICAL

MEDICAL

TRANSFERS

NUMBER OF PERSONS ADMITTED TO CAMP AND WORK SINCE LAST REPORT

NUMBER OF THESE ADMITTED ON CERTIFICATE OF VACCINATION FROM OTHER B.W.S. CONTRACTS

NUMBER OF VACCINATIONS PERFORMED SINCE LAST REPORT

DEATHS.

REMARKS.—

*INFECTIOUS DISEASES.

"a" CONTAGIOUS (VERY READILY COMMUNICABLE):—MEASLES; SCARLET FEVER; SMALL POX; CHICKEN POX; TYPHUS FEVER, RELAPSING FEVER

"b" COMMUNICABLE:—DIPHTHERIA (CROUP); TYPHOID FEVER; ASIATIC CHOLERA; TUBERCULOSIS; PLAGUE, TETANUS ANTHRAX; GLANDERS; EPIDEMIC CEREBRO SPINAL MENINGITIS, LEPROSY, INFECTIOUS DISEASES OF THE EYE; PUERPERAL SEPTICAEMIA; ERYSIPELAS; WHOOPING COUGH; EPIDEMIC PARALYSIS (POLIOMYELITIS); CANCER, PELLAGRA AND PNEUMONIA.

"c" INDIRECTLY COMMUNICABLE:—(THROUGH INTERMEDIARY HOST); YELLOW FEVER; MALARIAL FEVER; HYDROPHOBIA.

ATTENTION IS CALLED TO THE REQUIREMENT THAT IF ANY CASE OF COMMUNICABLE DISEASE BE DISCOVERED, OR ANY CASE OF DOUBTFUL DIAGNOSIS, IT SHALL BE REPORTED AT ONCE TO THE ENGINEER BY TELEPHONE OR MESSENGER AND CONFIRMED IN WRITING.

IT IS UNDERSTOOD THAT THE TERM "COMMUNICABLE DISEASE" IN THE SPECIFICATION REFERS TO ALL INFECTIOUS DISEASES AS ENUMERATED BELOW

RESPECTFULLY SUBMITTED,

Contractor's Physician

FIG. 6. CONDENSATION FORM FOR WEEKLY REPORT OF INFECTIOUS DISEASES USED AT CONTRACTORS' CAMPS

(Each page of the form is about 8½x11 in. overall. Each form covers three camps; the matter repeated has been omitted here.)

Vaccination against smallpox is compulsory and a certificate is issued to the men when vaccinated which is accepted on any other part of the Board's work if not over a year old. The New York City Department of Health supplies vaccine, diphtheria and tetanus antitoxines, antistreptococcus serum and typhoid vaccine free to the contractor's physician but the contractor is expected to furnish all other medical supplies. The doctor makes an inspection daily of all the buildings, entering each room in

the sleeping quarters, inspecting the incinerator and the general condition and appearance of the camp. He reports all irregularities and follows them up until they are corrected. Once a week a very complete report is made out in triplicate on a blank form furnished by the Board (Fig. 6), one copy going to the sanitary experts, one to the Department Engineer and one filed in the office of the division on which it originates. The report gives, among other things, the number of men, women and children in the camp, and the number admitted during the week. Vaccinations are recorded, the name of all persons receiving medical attention, the nature of their ailment and their condition on the day of the report. Cases requiring surgical treatment are described and the name of the hospital given in case the patient was taken there. The report shows the number of men employed on the work and not living in the camp and a statement of the general sanitary and health conditions of the camp and employees. Deaths are recorded giving the name of the person and the cause of the death. Cases of contagious disease and the like are reported immediately to the New York office of the sanitary experts, using telephone or telegraph and a code prepared for the purpose. Laboratory examinations are promptly made of samples from suspected cases. In short, all possible speed is made whenever there is the slightest evidence of any serious ailment, to obtain a correct diagnosis or to put preventive measures into operation. To those communicable diseases designated on the prescribed form of physicians report (Fig. 6) were added in 1911 under "B" Epidemic Paralysis, Cancer, Pellagra and Pneumonia, and under "C" Hydrophobia.

STATISTICS—The following statistics have been tabulated from the physicians weekly reports during 1911 and 1912:

	1911	1912
Weeks covered by reports	52	52
Average number living in camp	333	336
Average number living outside of camp	413	236
Maximum number living in camp	385	450
Surgical cases treated	178	189
Medical cases treated	...	100
Typhoid cases	...	20
Malaria cases	...	1
Measles cases	...	1
Whooping cough cases	...	...
Diphtheria cases	...	...
Scarlet fever cases	...	...
Influenza cases	...	3
Erysipelas cases	...	2
Acute dysentery cases	...	...
Pulmonary tuberculosis cases	...	6
Pneumonia cases	...	13
Bronchitis cases	...	10
Rheumatism cases	...	7
Tonsilitis cases	...	2
Mumps cases	...	...
Meningitis cases	...	2
Deaths—violent	1	3
Deaths—natural causes	...	

The record of the medical cases in 1911 is not as complete as the record for 1912 and is omitted except for typhoid. 1912 may be considered as typical for all cases in that year were recorded where the person was confined to his room or where, in an ordinary family, a physician would have been called. No case is entered twice, even though treatment may have been given for more than one week.

The number living in camp through the summer months ran about 440 in 1911 and about 400 in 1912. During 1911, 5 surgical and 1 medical case were sent to the hospital and 16 surgical and 14 medical in 1912. 276 vaccinations were made in 1911 and 179 in 1912. Prior to Jan. 1, 1911, 925 persons had been vaccinated.

THE OUTDOOR COOKING PROBLEM—No one will dispute that the outdoor cook house, the familiar shack built of stones or boards and roofed with old tin or sheet iron, with the usually accompanying unsanitary conditions and unwholesome sights and odors, is objectionable and ought to be eliminated absolutely. The problem often presents complications, however, and some of the factors are set forth herewith, followed by a statement of the conditions existing in Camp Hill View.

Irish, Negroes, Hungarians, Austrians, Poles and Swedes prefer to have a woman prepare their meals and they will eat in the mess halls without any question. Italians and Portugese, however, persist in cooking their own food and in building a shack to do it in. The custom is a deeply rooted habit of the race, the question of economy not entering as an important element, although both nationalities are very frugal. These men combine into small groups, usually for the reason that they come from the same township in the "old country," or that they speak a similar dialect, and the members of each group insists upon cooking and eating by themselves, although mingling freely at other times. Thus it is that the outdoor cook house in this camp, with its 20 fireplaces, is not looked upon with favor. There will always be found one man in each group whom the others will look to as a sort of leader, a man usually of more intelligence and through whom sometimes a certain amount of reform can be brought about if one cares to go into it to that extent. Usually, however, any interference with this most tenaciously-clung-to custom is resented and the groups are often so closely bound together that the discharge or disciplining of one of their number will result in all leaving the work. The shack unquestionably acts as a sort of bond between the men and the job. If they find that they are to be permitted to follow this cherished custom they settle down, so to speak, and are not interested in looking elsewhere for work, a very desirable attitude from the contractor's point of view. It is among the Italians and Portugese that the cheapest class of labor is obtained, so the simplest solution would be for the contractor to pay a wage high enough to attract other nationalities and then prohibit the shacks absolutely, a solution, however, that cannot often be brought about. The way the matter stands in Camp Hill View at present is to permit the shacks in a limited number, to concentrate them in one locality, and to give especial attention to this area in the daily cleaning up around the camp. This area should be cleaned early each morning as the evening meal is the only one for which any considerable amount of food is prepared and cooked and, therefore, is the source of the scraps and garbage that, by decomposition, cause the unsanitary conditions and attract flies. The area in this camp is systematically cleaned, washed down several times through the summer with a stream of water from the fire hose, and is not offensive in smell or appearance.

CONCLUSION—The camp presents a neat and orderly appearance, free from offensive sights and odors, and has few flies or mosquitoes during the summer. During the two years and eight months that the camp has been in operation, it has been visited by many interested in social as well as sanitary problems. The health records are very satisfactory and the absence of fly-borne diseases is noticeable. No difficulties have ever been thrown in the way of those whose duty it has been to

see that the regulations were being carried out but experience has proven that a certain amount of vigilance is essential to the keeping up of the standard. One direct result of the supervision is manifest in the general character of the contractor's force. They are of a higher physical standard than in most camps. They are contented and law abiding. There is very little disorder either on the work or in the camp. The work has proceeded with no delays, with little friction and doubtless with more efficiency, a fact of importance to the contractor from a practical standpoint and indirectly to the Board with its desire to deliver water to New York City at the earliest possible moment. From a sanitary and humanitarian point of view it has certainly registered a long forward step and the results are most satisfactory to those who have the interests of the measures at heart.

J. Waldo Smith is chief engineer of the Board of Water Supply, Frank E. Winsor is department engineer and Chas. E. Wells is division engineer, in charge in the field of the construction of this portion of the line.

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Committee Reports on Sewerage and Sewage Disposal and on River Cleaning

The sanitary enginering section of the American Public Health Association has a number of standing committees. Among the reports submitted by these committees at the meeting held in Colorado Springs in September of this year was one on sewage collection and disposal, and another on river cleaning. Abstracts of these reports are given below, together with some points brought out in a paper on shell fish and sewage disposal, which was in a measure supplementary to the report of the first named committee.*

Committee on Collection and Disposal of Sewage

The members of this committee are Geo. S. Webster, chairman, Frank A. Barbour, Geo. A. Johnson, F. Herbert Snow, J. L. Ludlow and Langdon Pearse. The report of the committee partook largely of the nature of a concise summary of the principles governing sewerage and sewage-disposal systems at the present day. It is, therefore, unnecessary to do more than call attention to some special points in the report.

Velocity of Flow—For self-cleaning velocities [ideal] gradients should not be less than 2 ft. per sec. for separate and 2½ ft. for combined systems. Lesser gradients in order to decrease trench excavation are often used. These require more frequent flushing but otherwise give no trobule provided a smooth interior surface is secured. Well constructed, reasonably flushed sewers, taking domestic sewage only, may have velocities as low as 1 ft. per sec.

Ventilation—The omission of the house trap and ventilation through the main house riser is favored by the committee.

Trade Wastes—The following classification of trade wastes with a few words of comment may be quoted from the report, as follows:

(a) Heavy mineral solids, such as lime from glue works, dust from marble yards, etc., can form deposits in the sewers which retard the flow and reduce the carrying capacity.

(b) Gelatinous materials, hair from tanneries, grease from wool works, and similar substances, by adhering to the perimeter, increase the roughness of the interior surface and so reduce the carrying capacity.

(c) Acid wastes injure the cement joints between brickwork or pipes, or attack concrete, causing leakage and destruction of the fabric of the sewer.

(d) Liquids of high temperature may soften and injure the bituminous joints in pipe sewers used to prevent the infiltration of ground-water.

(e) The discharge of live steam, volatile liquids or inflammable gases, or the sudden emptying of vats of hot water, cause a serious menace to men working on the sewers.

Trade wastes having the above properties should be strictly excluded from the sewer system, unless submitted to sufficient treatment to remove the objectionable characteristics, as, for instance, the wash-water from garages contains gasoline, which can be easily removed by passage through an intercepting tank, as required in London.

In regard to the admission of other trade wastes, it may be said that it is cheaper to dispose of manufacturing wastes in combination with the sewage than separately, and sometimes purification is only made possible by admixture with the sewage. Generally, it is good civic policy to aid manufacturing interests by providing an outlet for the liquid wastes, but obviously, since there is no greater obligation on the part of the community to take care of liquid than of solid manufacturing refuse, the power should be given those in authority to levy special assessments, based on some logical expression of the increased cost of maintaining the sewerage systems caused by the entrance of these wastes. Further, it is evident that in many cases preliminary treatment of the manufacturing wastes must be required, and none should be admitted which will injure the sewer, increase the cost of maintenance beyond that involved in independent disposal, or prejudically affect the treatment of sewage.

Finance and Assessments—In discussing the methods of raising money to pay for sewerage systems, the committee suggested the cost should be distributed "in proportion to the benefits conferred" in accordance with the following plan:

Thus, if a small part of the total expense is met by a general levy on all property to express the sanitary betterment to the entire community, a larger part is raised by assessment on property abutting on streets where sewers are built, whether those sewers are used or not, and a still larger part is obtained by rentals for actual use, the relative benefits will be fairly indicated, and the opposition to the improvement by those not particularly in need of sewers may be thus removed.

Methods of Treatment—As regards sewage disposal and methods of treatment, the committee, as might be expected, gave expression to the very sensible view that is now generally accepted by engineers to the effect that the kind and degree of treatment should be governed entirely by local conditions, taking into account the whole drainage area of the stream and the use to which the water of the stream below the point of discharge of sewage effluent is put. The summing up under this heading may be quoted from the report as follows:

(1) Sewage, or effluent from treatment works, must continue to be discharged in increasing quantities into running waterways and tidal estuaries.

(2) The establishment and maintenance of conditions offensive to the æsthetic senses through such discharge of sewage must be guarded against.

(3) Where sewage is treated so that upon its discharge into the rivers and tidal estuaries no offensive conditions are set up as regards objectionable appearance and odors, and no undue load is placed upon the water filters within the influence of the sewage discharged, and where a suitable margin of safety is allowed; the problem of sewage disposal, broadly speaking, has been solved.

With few exceptions, all sewage should receive some form of treatment, in order that offenses shall not result. These refer, first, to overtaxing the digesting or oxidizing power of the diluting stream; second, to the formation of sludge deposits on the bed and banks of the stream, these deposits putrefying later and setting up and maintaining offensive conditions; and, third, the presence of floating material and oily sleek.

*The reports and paper will be published in the "Journal" of the association.

Omitting from the problem of sewage disposal the influence on water-supplies, it may be said that, with sufficient dilution and adequate velocities, screening to remove floating matter is the minimum degree of treatment required in any case. Usually, however, it is necessary to go further and remove the heavy suspended matter, leaving only that which is light enough not to deposit in the stream, and if the flow of the stream is sufficient to dilute the clarified sewage and prevent offense, the problem is solved.

FISH AND SHELLFISH INDUSTRY—Regarding the fish and shellfish industry, the committee said:

The fish industry is not usually affected in moderately polluted waters, unless certain trade wastes are present to taint the flesh with tastes, or poison the fish. The amount of pollution must be carefully studied, as well as the minimum oxygen content to determine whether the environment is favorable. Fish are usually eaten after thorough cooking.

With shellfish, which in numerous instances are consumed uncooked, it is different, inasmuch as it is not feasible to render sewage innocuous by itself, dangerous bacterial contamination of shellfish grown in grossly polluted waters cannot be prevented. And generally the value of shellfish industries is of far less importance than the comfort and convenience of cities and towns which are forced by circumstances beyond their control to use running water for the disposal of their sewage.

The conservation of the shellfish industry in polluted waters may be aided by the sterilization of sewage before discharge therein, but shellfish should not be harvested or marketed from water exposed to sewage pollution except in such localities where properly instituted technical authorities shall determine the origin of pollution to be sufficiently remote from the shellfish beds to avoid contamination.

SKILLED SUPERVISION—Particular emphasis is laid in the report upon the necessity of skilled supervision of sewage-treatment works and of either state or Federal control of the operation of these works.

LABORATORY CONTROL—The value and importance of laboratories as aids or guides in the operation of sewage-treatment works is discussed by the committee near the close of its report as follows:

LABORATORY CONTROL

The operation of a sewage-treatment works is usually controlled by laboratory observations.

The methods generally used are largely adapted from the sanitary examination of water, and in many ways this work could be simplified.

What the operating engineer needs to know is whether each part of the works is being operated at its maximum efficiency, and whether the final effluent is suitable for discharge into the stream to maintain the standard set for that stream. For purposes of comparison with other cities more complete analyses are often desired of the crude sewage and of effluents. For instance, in the operation of a grit chamber the only important observation is the percentage of the dry residue which is organic, for if it is too high the velocity of flow through the grit chamber should be increased.

In the operation of a percolating filter it is most important to know whether the filter is delivering a stable effluent, and the storage and unloading of the suspended matter.

The most important facts required on sewage or effluent are the amount of settling material contained, the avidity for oxygen, and possibly the prevalence of pathogenic organisms.

The methylene blue test for stability marked a considerable advance, but even this has its limitations owing to the need of more extended data. Perhaps if natural conditions could be more nearly imitated the results would be more valuable. Small sample bottles, incubated airtight, afford quite different conditions from those existing in a normal stream with its constant absorption of oxygen from the air and the addition of oxygen liberated from green plants in the water.

Tests which show the results of the biological activity in the exhaustion of available oxygen in the sample tell more clearly the fitness for an effluent to be discharged than the quantitative chemical analyses of the sample.

FUTURE STUDIES—Finally, the committee suggests these recommendations for future work of the committee:

The Council, in appointing this committee, asked that it should make recommendations for special fields for committee work.

In accordance therewith, it is recommended that a joint committee of the Vital Statistics Section and the Sanitary Engineering Section be appointed to make investigations and report upon the effect upon the death rate attributable to introduction of a system of sewers.

Also the relative efficiency in the protection of the public health by the filtration of water and by the treatment of sewage as measured by the death rate from water-borne diseases.

That a joint committee of the Laboratory Section and the Sanitary Engineering Section be appointed to make investigations and report upon standard methods for the operation and supervision of sewage disposal works.

PAPER ON SHELLFISH CONSERVATION AND SEWAGE DISPOSAL

A paper with this title, by George A. Johnson, of New York City (a member of the Committee just noted) first reviewed in a brief and interesting way the possible dangers to public health from shellfish. It was pointed out that the total annual output of the shellfish industry in the United States is now some 40,000,000 bu., valued at about $20,000,000. Of this, nearly three-fourths is "controlled by New York, Virginia, Connecticut, Maryland, New Jersey, Rhode Island, Louisiana and Massachusetts. In discussing how shellfish grounds may be protected from sewage pollution without putting an undue burden upon municipalities, Mr. Johnson said:

Until the dream of the idealist is realized, and all sewage is made innocuous before discharge there seems to be little hope that shellfish, where usually cultivated, are not to be considered to be and still remain a potentially dangerous article of diet for human consumption unless perhaps, after being harvested, they are removed to an unpolluted water and there allowed a period for self purging before being placed on the market. It seems to be reasonably certain that polluted shellfish when placed in constantly changing, unpolluted water, will purge themselves of impurities in from one to two weeks. This department of oyster cultivation and harvesting has received altogether too little attention in the past.

This refinement in the preparation of shellfish for the market may not be the ultimate answer to the problem, but it deserves exhaustive study. If the results of such studies prove favorable there should not be a sensible oysterman who would not gladly adopt it for with the coöperation of a supervising Federal or state authority he would then be enabled to furnish for the market certified shell fish, and the thinking consumer could never object, but rather should heartily approve, of an increase in the selling price sufficient to cover the cost of such treatment, being assured of the purity of the food he is consuming.

Until prohibited by Federal or state authorities shellfish, polluted and clean, will continue to appear on the table, and even if forbidden for public sale, they will still be used. Except in special well adapted cases it is impossible on financial and other grounds absolutely to conserve the purity of shellfish by sewage treatment. Complete treatment of the sewage entering waters which flow over shellfish layings will improve existing conditions, and in special cases almost, if indeed not entirely, remove the existing danger, but to be thoroughly effective a condition is required, which is seldom, if ever, found at sewage-treatment works today. There would be required not only extreme conscientiousness in the operation of the sewage-treatment works, paralleling the vigilance with which good water-filtration works are watched, but also interstate coöperation, the whole order of affairs being supervised by a supreme authority vested by law with power to approve or condemn.

The conservation of the shellfish industry is a difficult problem, made so by the fact that common-law rights of sewage disposal into the sea and its estuaries have been and are being extensively utilized. To set these conditions back a century solely for the sake of conserving the oyster industry, where no other offense is created, is a matter which, if pressed, will engage active sanitary, financial and legal minds for many years to come.

REPORT OF THE COMMITTEE ON RIVER CLEANING

The members of this committee are Geo. C. Whipple, chairman, Paul Hansen, secretary, Andrew J. Provost,

Theodore Horton and Harrison P. Eddy. The committee stated that since the problems which it has to study have so many phases and require data which can only be obtained by detailed investigations made by municipal, state and national authorities, the most the committee can be expected to do is to coöperate in such investigations and to try to "crystallize the results as they become available from time to time." The committee also stated in passing that its title, River Cleaning, does not seem to be well chosen, and it therefore proposes to substitute "Sanitary Control of Waterways" hereafter.

After outlining the various viewpoints from which the pollution of waterways may be considered, the committee stated that much of the confusion regarding water pollution which now prevails "in the popular mind, and even in the minds of sanitarians, results from failure to appreciate the impracticability of applying the same standards to all waterways." The committee then proceeded to take up various viewpoints as follows:

(1) Where the only thing necessary to do is to prevent nuisance "no greater requirement need be made than that the water be non-putrescible, free from unsightly color and suspended or floating matter, and that no sludge banks or other objectionable deposits be formed." Standards for use in this connection based on the oxygen-absorbing powers of the water have recently been proposed by the Royal Commission on Sewage Disposal (British) and by the Metropolitan Sewerage Commission of New York City.

(2) Where public water-supplies are involved the standard ought not to rest upon analysis alone, but upon the sanitary conditions of the watershed and the knowledge of the stream in general.

On the important subject of stream pollution in relation to water-supply we quote from the report in full as follows:

> (2) The permissible degree of waterway pollution where such waterways are used as sources of public water-supply is very difficult to determine, yet there is apparently a need for some such standard, even though it be a somewhat arbitrary one.
>
> When such a standard is established it ought obviously to rest not upon analyses alone, but quite as much upon the sanitary conditions of the watershed as revealed by inspection, upon knowledge of stream flow at high and low water, the population and industries tributary to the sewers, the distance of pollution above the water-works intake, and the like. In other words, some index must be obtained of the danger of infection. Nor must the æsthetic sense of the community be offended by using water obviously foul.
>
> Your committee regrets that it cannot present at this time a suitable index to be used as a standard for waterways that come within this grouping.

(3) In water used for recreation purposes "esthetic considerations must play a predominant part." There should be no evidence of sewage to the eye or nose, and if the water is to be used for bathing purposes untreated sewage should not be admitted "except at points so remote that self-purification is assured at all stages of the water."

(4) Where fish are involved "the permissible degree of pollution in a waterway is an essentially economic proposition, to be decided after a comparison of the damage done or expected, and the cost of preventing the damage." Experiments are needed to determine the quantities of oxygen needed to support fish life.

The greatest danger to shellfish arises "from comparatively small quantities of polluting matter not perceptible to the unaided senses, and here rather delicate methods of bacterial analysis are needed to indicate the danger." Studies of plankton are needed in connection with both fish and shellfish in relation to sewage treatment since each is dependent largely upon plankton for food.

(5) The danger of sewage pollution to cattle "should also be regarded as one to be settled upon economic grounds." Anthrax is "about the only specific disease" involved, and this is very rare in the United States. More data are needed to determine the dangers to cattle from polluted waterways.

(6) The measure of injury to industries by water pollution is also an economic one.

(7) Sludge banks must be given some consideration, although only rarely to the results from sewage disposal proper, being found more frequently in connection with various sluicing operations. The report states that "sludge may result from undue restriction of waterways by heavy deposits of waste."

(8) Polluted water when used in irrigation may give rise to offensive odors if it lies upon the irrigated fields. There is also a "somewhat remote danger" of pollution of fruits and vegetables eaten raw after having come in contact with polluted irrigating water. Under ordinary conditions all that it is required for irrigation waters in the way of regulation of pollution is "a condition of stability." This subject, however, needs further study.

The concluding portion of the report is as follows:

> It will be noted that in the foregoing discussion comparatively little emphasis has been placed upon the relation of waterway pollution and public health, but that much stress has been placed on the economic phase of waterway sanitation, and it is important that this phase be most fully recognized. As a mere matter of civic cleanliness and public decency public places and public waterways should be kept in a reasonably clean condition, but in approaching the solution of any problem involving waterway sanitation the question should invariably be asked, "what is the value of the benefits derived as compared with the cost of maintaining the stream in an acceptably clean condition?"
>
> Broad generalizing must be avoided, for nearly every waterway is a law unto itself, varying in its remoteness from public view, in its variations between high and low water, in the accessibility of its banks, in the uses to which it may be put, and the physical condition of the water in its normal state and in other ways.
>
> The legal control of stream pollution and the sanitation of waterways varies greatly in the different states. In order to exhibit these differences and at the same time to ascertain their relative usefulness the committee has invited the engineers of a large number of state departments of health to present brief papers discussing the operation of the laws in their several states. And the committee wishes to take this occasion to thank those who have so kindly accepted this invitation.
>
> We hope that these presentations will form the nucleus of a more detailed compendium of existing state laws on the subject of streams pollution, to be prepared during the coming year, should the section see fit to ask the committee to continue its work.

⁂

The Prevention of Corrosion of iron in acid waters with an electrolytic method is proposed by the U. S. Bureau of Mines, which has made experiments with iron submerged in sulphuric-acid solutions. The metal structure to be protected is to be made the cathode of the circuit, that is, current flows from the water to it. The current density and the actual current required for protection can be calculated from experimental data on the loss in weight of the metal when unprotected under the given conditions reproduced as near as possible. This loss in weight per hour per unit area, divided by the electrochemical equivalent (weight dissolved or deposited per ampere-hour) gives the current density to be employed. This multiplied by the actual area to be protected gives the actual current needed. It is obvious that for good protection, the anodes, by which current is led into the water, should be distributed as much as possible so that the current may not return to the protected structure at one point only.

The Elkhorn Railway Extension

By O. K. Morgan*

SYNOPSIS—The railway extension described in this article is the final link in a new route from the Ohio River valley to the manufacturing districts and ports of the South Atlantic states. It has a continual ascending grade from a valley bottom to a mountain summit. It is essentially a tunnel line, having no less than 21 tunnels (the longest 7804 ft.), while there are only eight bridges, the policy of the location being to pierce the mountain spurs rather than to span the ravines. Some heavy construction work was included on this line, and the article describes both the characteristics of the line and the methods of construction.

The original conception of the Carolina, Clinchfield & Ohio Ry. embodied a line extending from Elkhorn City, Ky., the terminus of the Big Sandy Division of the Chesapeake & Ohio Ry., southward to Spartanburg, S. C., which is a railway center, with lines to Atlantic coast ports. For various reasons, however, the construction of the line between Elkhorn City and a point about 35 miles south (known as Dante, Va.) was not undertaken at the same time that the remainder of the line was constructed in 1906, 1907 and 1908. The railway was described in ENGINEERING NEWS, Jan. 21 and June 10, 1909.

In May, 1912, it was decided to construct the Elkhorn Extension, or the northern portion of the line, about [illegible] miles long, to its connection with the Chesapeake & Ohio Ry. Its completion will give a short rail route from the Ohio Valley to the Carolinas and the south Atlantic seaboard, and will effect a considerable saving in distance and time between many of the prominent commercial points in each of these territories, as may be seen by the smaller map in Fig. 1. This extension also, will open up a large undeveloped territory rich in timber, coal and other minerals for practically its entire length. The general conditions are shown by the map and profile, Figs. 1 and 2.

The town of Dante, Va., lies at an elevation of 1760 ft. above sea level. It is on the south slope and in one of the deep hollows of the so called Sandy Ridge, a range of the Cumberland Mountains, which has a general northeast and southwest trend for a distance of about 100 miles, and which connects on the south end with the main range of the Cumberland Mountains. The average height of the range in this vicinity is about 2700 ft. above sea level. Elkhorn City has an elevation of 795 ft. at the C. & O. Ry. station, and lies in a loop of Russell Fork, surrounded by high mountains.

The problem of passing Sandy Ridge by a satisfactory line was the most serious one encountered in building this connecting link, and engaged the attention of the

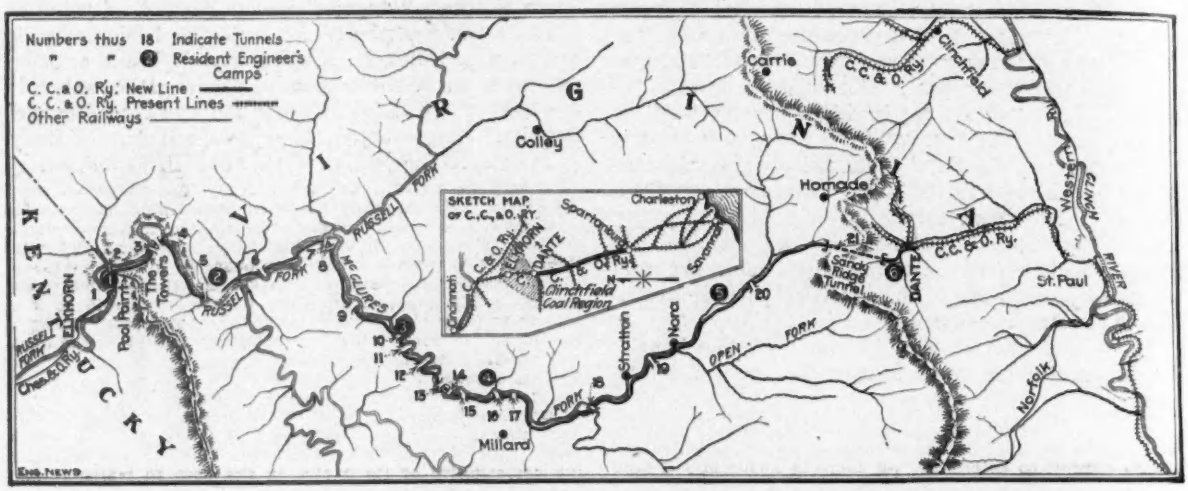

FIG. 1. MAP OF THE ELKHORN EXTENSION OF THE CAROLINA, CLINCHFIELD & OHIO RY. (WITH SMALL-SCALE MAP OF THE C., C. & O. RY.)

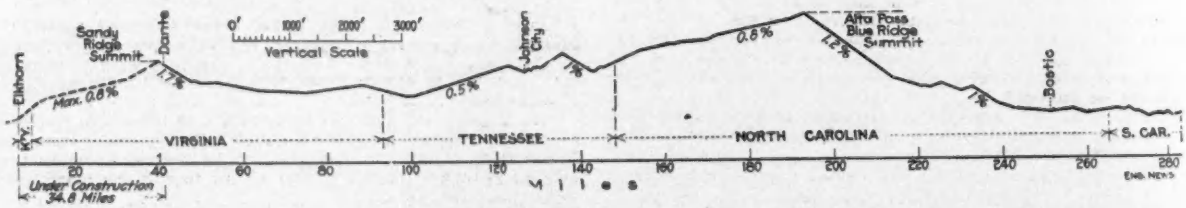

FIG. 2. PROFILE OF THE CAROLINA, CLINCHFIELD & OHIO RY., INCLUDING THE ELKHORN EXTENSION

*Office Engineer, Carolina, Clinchfield & Ohio Ry., Johnson City, Tenn.

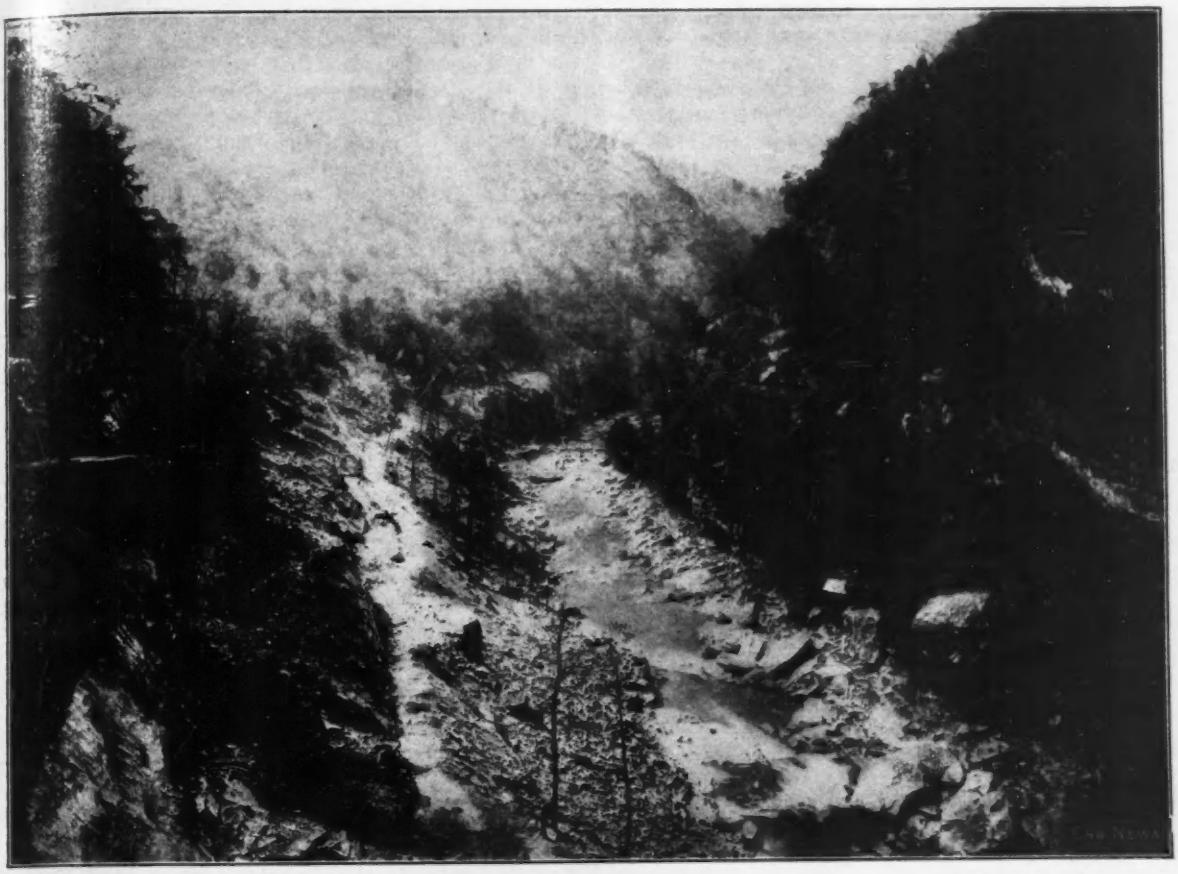

FIG. 3. RAILWAY CONSTRUCTION THROUGH "THE BREAKS" IN THE PINE MOUNTAIN RANGE (CUMBERLAND MOUNTAINS); KENTUCKY-VIRGINIA

engineers from time to time for a period of seven years. This study resulted in the final adoption of the present plan, calling for a tunnel 7804 ft. long.

After passing Sandy Ridge going north, the line follows the valley of McClure Fork (a tortuous mountain stream) for a distance of 21 miles. Thence it follows the valley of Russell Fork for 11 miles to Elkhorn City. Russell Fork is a tributary of the Big Sandy River, which breaks through the Pine range of the Cumberland mountains by a deep, tortuous, rocky gorge known as "The Breaks." This region is notable in Kentucky, Virginia and West Virginia for its general inaccessibility from the outside world. The character of the country is indicated by the accompanying views. Fig. 3 is a view in "The Breaks," between "The Towers" and the State Line tunnel (No. 2). Fig. 4 shows the roadbed beyond the Pool Point tunnel (No. 1), looking north from the ridge above the north portal of the tunnel.

FIG. 4. ROADBED NORTH OF POOL-POINT TUNNEL, ALONG RUSSELL FORK, IN KENTUCKY

(The lower right-hand corner of the view is over the portal of the tunnel.)

CONSTRUCTION WORK

The difficulties of construction of this line are those usually attendant upon building a 10° line in a 20° country, which means either many tunnels or many stream crossings. On account of the difficulty of getting in supplies, as well as considerations of future maintenance and satisfactory grades, it was decided to make a free use of tunnels and eliminate as much bridging of streams as possible. For this reason, while there are

only eight bridges (with an aggregate length of 2125 ft.), there are 20 tunnels with a total length of 20,531 ft.

The line in general lies on the steep mountain slopes, well above the stream bed. The work is heavy, about 70% of the grading being solid rock. About 3,000,000

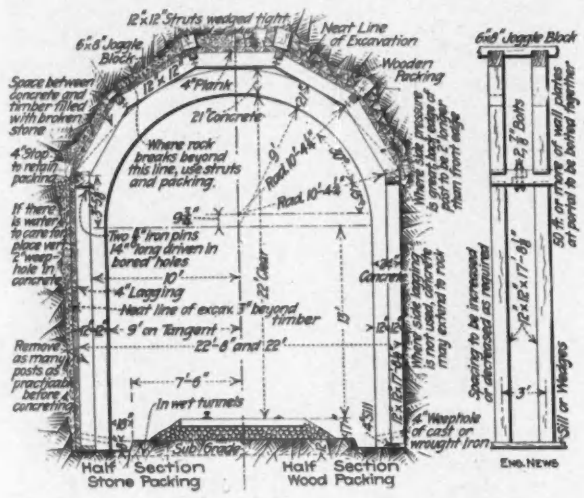

FIG. 5. STANDARD TUNNEL SECTION; CAROLINA, CLINCHFIELD & OHIO RY.

cu.yd. of grading and 26,000 cu.yd. of masonry are required. The work has no unusual features, except those due to the rough topography and generally inaccessible nature of the country. These conditions increase the difficulties of getting in supplies and keeping labor, and required the building of new roads. The labor trouble seems perennial with all jobs remote from the big centers of population.

There are eight steam shovels on this outside work (exclusive of those in the tunnels). Several of the cuts exceed 50,000 yd. One fill has 180,000 yd. and is 90 ft. high; another has 154,000 yd. and is 95 ft. high. Viaducts were originally contemplated for these, but fills were decided upon later.

Construction was started in June, 1912, and it is expected that the line will be completed early in 1914. The Sandy Ridge tunnel is the controlling point which determines the time required for completing the line.

CURVES AND GRADES

The maximum curve is 10°, and 10° curves are rather numerous, due to the configuration of the country. The average curvature is 6° 26′ and the total curvature 6339°. The percentage of tangent in the line is 45.7%, which is high for this sort of country. All curves of 3° and over have transition curves (Talbot's system), and all curves on grades are compensated at the rate of 0.035% per degree of curve.

The grades are all ascending southward from Elkhorn City to the southern end of the Sandy Ridge tunnel, beyond which there is a descent for a short distance to the connection with the present line at Dante (Fig. 2). The grades are approximately as follows, starting at the Elkhorn end, and all are compensated for curvature: 7 mi. with a maximum of 1.5%, 19 mi. with a maximum of 0.8%, 6 mi. of 1%, 1½ mi. of 0.5% through the Sandy Ridge tunnel, and finally 1.3 mi. of 1.8% descending grade into Dante.

It is probable the heavier traffic will be southbound, and the 1.5% grade near Elkhorn and the 1% grade up to the Sandy Ridge tunnel will be operated by helpers. The total ascents are 1046 ft. and total descents 76 ft. Much attention was given to the matter of grades and it is believed these grades give the best operating conditions obtainable for a line of this cost, which will be approximately $5,000,000. The train loads will approximate 2700 tons, hauled by a single Mallet locomotive of 72,300 lb. tractive power, assisted on the pusher grades by a 2:8:0 locomotive of 40,000-lb. tractive power.

TUNNELS

The standard tunnel section of the C., C. & O. Ry. is shown in Fig. 5. It is 18 ft. wide and 22 ft. high in the clear, after lining is in place, and gives ample space overhead for smoke and ventilation, as well as ample side clearance. Fig. 6 shows the south end of the Pool Point tunnel (No. 1), and immediately in front of it is the form for the abutment of the bridge which will carry the line across the river. The same condition exists at the Skagg's Hole tunnel (No. 5), except that this tunnel is not so high above the water.

All except two of the tunnels are being driven by the common method of first excavating the heading and then

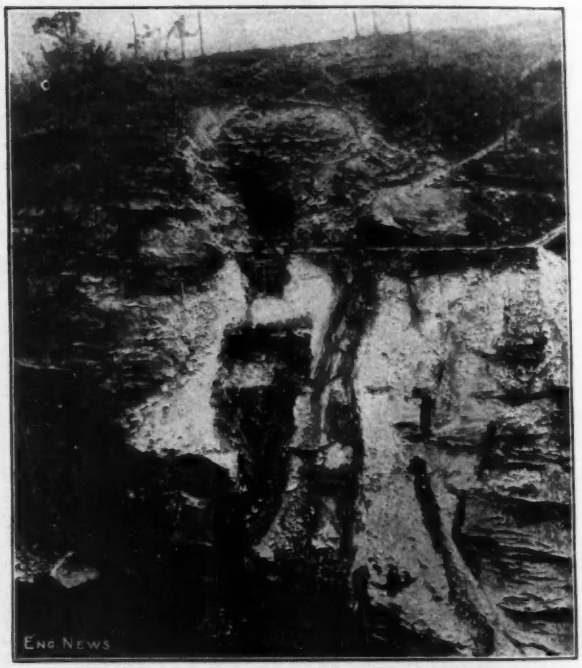

FIG. 6. SOUTH END OF THE POOL-POINT TUNNEL, AND NORTH ABUTMENT OF THE POOL-POINT BRIDGE (115 FT. ABOVE THE WATER LEVEL OF RUSSELL FORK)

the bench. The two exceptions are where the material is such as to require immediate placing of a timber lining, in which case the bench is kept close up. A steam shovel is being used to take out the bench of those known as the Goff, Red Ridge and Sykes tunnels. For the lined section of tunnel, the approximate quantities per lin. ft.

of tunnel are as follows: net excavation (to 3 in. outside of timbering), 21.7 cu.yd.; concrete lining, 4.61 cu.yd.; timbering, 600 ft. b.m. In wet tunnels, the engineer may require the bottom to be excavated 1 ft. below subgrade, for which the contractor is allowed 0.66 cu.yd. per lin.ft. of tunnel.

While nothing has been done toward lining any of the tunnels of this extension, the methods used will probably be similar to those used for the past three years on the present operated line. The concrete is mixed by a machine at a plant conveniently placed near one portal and is deposited by gravity in the specially equipped scaffold-car shown in Fig. 7.

This car is hauled by a cable attached to the drum of a hoisting engine, being moved in and out of the tunnel to and from a temporary siding. From the various decks of this car the concrete is shoveled into place. Wooden forms are used. The method has proved very economical and satisfactory.

The width of tunnel on curves is shown in the following table, which gives also the superelevation and speed allowed. The total width in any case is 18 ft.

Curve Deg.	Width of tunnel on curves Inside curve Ft.	Outside curve Ft.	Superelevation In.	Speed m.p.h.
1	9.14	8.86	1	45
2	9.26	8.74	1½	36
3	9.35	8.65	2½	35
4	9.42	8.58	3	34
5	9.49	8.51	3½	33
6	9.56	8.44	4	32
7	9.63	8.37	4½	31
8	9.63	8.37	4½	29
9	9.63	8.37	4½	27
10	9.63	8.37	4½	26

Sandy Ridge Tunnel

The construction of this tunnel governs the time required for the completion of the line, as explained above. Consequently, every effort was made to get this under way first. The contractors immediately put two large steam shovels at work on the south approach cut, which contained 70,000 yd.; and as soon as a shovel could be got across the mountain, work was begun on the north approach cut, containing 55,000 yd. The south heading was started in the middle of October and the north heading the middle of November, 1912. The present rate of progress is about 100 ft. per week for both ends, heading and bench being driven close together.

The tunnel is being driven from each end, no shafts being used. The method of driving is as follows: the heading is driven about 12 ft. in advance of a sub-bench, which in turn is about 10 ft. in advance of the bottom bench, and all are shot together. Drilling is done by 3¾-in. Ingersoll-Rand drills operated by compressed air. Mucking is done by Marion shovels, also operated by compressed air, the machines being equipped with air receivers instead of boilers. These shovels are fitted with 1½-yd. special rock buckets.

Compressed air is furnished from two plants, one near each end of the tunnel, and each equipped with an Ingersoll-Rand compressor with a capacity of 1800 cu.ft. of free air per minute. The compressor is belt-connected to a 300-hp. electric motor receiving current from a private power plant. The current is 6600 volts and passes to a transformer at the compressor plant, which delivers it to the motor at 2300 volts. From the compressor the air goes to a receiver 54 in. diam. and 12 ft. long, thence by an 8-in. pipe line to the tunnel portal. At this point it reduces to a 6-in. line for a distance of 1000 ft., then it is further reduced to a 5-in. line, and carried to the drills and to the air receiver on the power shovel.

Haulage of the muck is done by two electric locomotives at each end of tunnel, handling 4-yd. dump cars. The locomotives at the north end are each of 5 tons weight; at the south end there is one of 5 tons and one of 6 tons. They all receive 250-volt direct-current from a No. 00 wire of figure 8 section, current being generated by a 125-hp. motor at each compressor station.

To expedite ventilation, which during certain weather conditions is poor, there has been installed at the south end a fan, driven by a 20-hp., 2300-volt motor. The displacement of the fan is 2500 cu.ft. of air per minute, which is drawn from the tunnel through an air line of

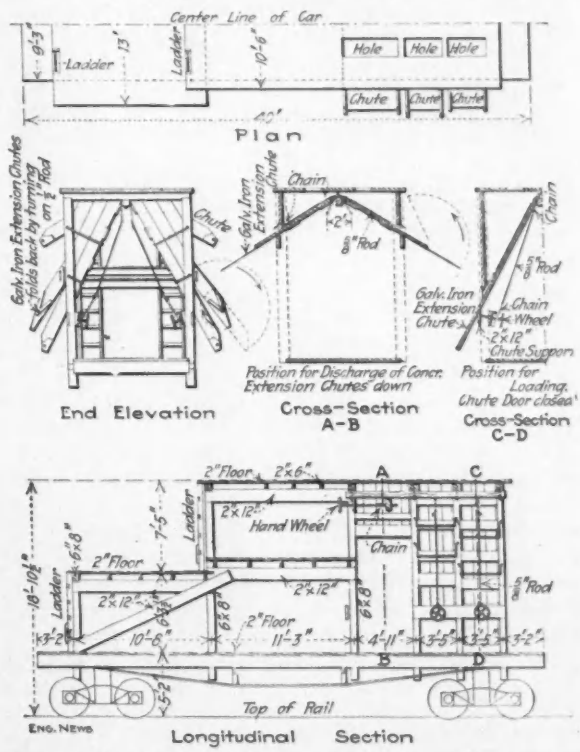

FIG. 7. CONCRETE CAR FOR DELIVERING CONCRETE TO THE FORMS FOR THE TUNNEL LINING; C., C. & O. RY.

galvanized sheet iron 14 in. diameter. A ventilating plant will soon be installed at the north end of the tunnel. The tunnel is lighted by electricity on a 220-volt circuit, from a small transformer located at the compressor plant.

At present the force is being worked in two 10-hr. shifts, except Sundays. At the south end, the material is gray slate with sandstone roof. At the north end, it is gray sandstone with seams and some slate on the bottom. It is probable that a portion of the tunnel will need lining.

Bridges

Seven of the eight bridges have deck plate-girder spans, and there is only one truss span. The substructure work is of concrete, and Fig. 8 shows the two abutments and four piers for the Open Fork bridge at Nora,

Va. This has three girder spans of 70 ft., with a height of 40 ft. from low-water level to the rails. All the bridges are designed for the E-60 loading of Cooper's specifications. When a bridge occurs at a curve, the

FIG. 8. CONCRETE PIERS AND ABUTMENTS OF THE OPEN CREEK BRIDGE, NORA, VA.; C., C. & O. RY.
(The view shows the temporary trestles used in building the approach embankments.)

span is tilted by varying the height of the shoes, thus securing the proper superelevation of the track without placing corbels under the ties.

The truss span is in the bridge crossing Russell Fork at Pool Point, two miles from Elkhorn City. The site of this (immediately south of the tunnel) is shown in Fig. 6. The bridge crosses the river over a pool 50 ft. deep, and is 115 ft. above the water. During freshets this pool becomes a veritable whirlpool, and unusual precautions in the erection of this bridge are necessary, as floods are liable to occur at any season of the year. It was finally decided by the bridge company having the contract, to erect the truss span by means of a temporary steel falsework of A-frame construction.

This bridge has a deck span of 270 ft., with a girder span of 50 ft. at one end and 70 ft. at the other, as shown

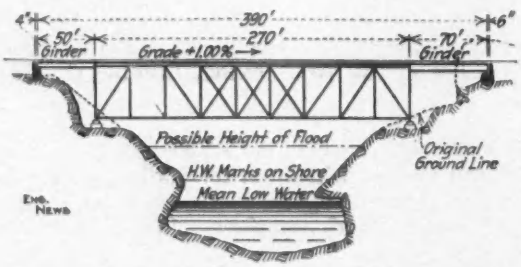

FIG. 9. THE POOL-POINT BRIDGE; CAROLINA, CLINCHFIELD & OHIO RY.

in Fig. 9. It is on a grade of 1%, and at its lower end is the spiral or transition curve of a 7° curve. It will be seen that the masonry consists merely of four small pedestals for the truss seats and two small abutments. The pedestals are 8x8 ft. on top, with sides battering 3:12. They are reinforced near the top by two layers of ¾-in. bars, the bars being wired together and having the ends bent down vertically about 9 in. The concrete is a 1:2:5 mixture for the abutments and 1:2: the pedestals and the bridge seats on the abutment north abutment is only 50 ft. from the tunnel

ROADBED AND TRACK

The roadbed is being constructed 22 ft. wide in 20 ft. in rock, and 18 ft. on embankments, in accor with the sections shown by Fig. 10. The ditches made exceptionally wide to accommodate the

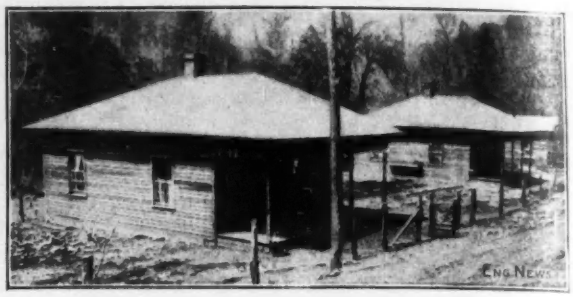

FIG. 11. RESIDENT ENGINEER'S HEADQUARTERS NEAR MILLARD, VA. (RESIDENCY NO. 4); C., C. & O. RY.
(When the line is opened these buildings will be occupied by the section foremen and section gangs.)

ditcher, which this road uses in maintaining its ditches. The track will be laid with 85-lb. openhearth steel rails of the Am. Soc. C. E. section, in 33-ft. lengths, with Bonzano joints, ⅞-in. Harvey grip bolts and 2880 ties per mile. Passing sidings with a clear length of 4000 ft. are provided at intervals of about 7 miles.

The engineers' quarters of residency No. 4, near Millard, Va., are shown in Fig. 11, and this is typical of the character of the buildings constructed. These buildings will be used by the section foremen and gangs after

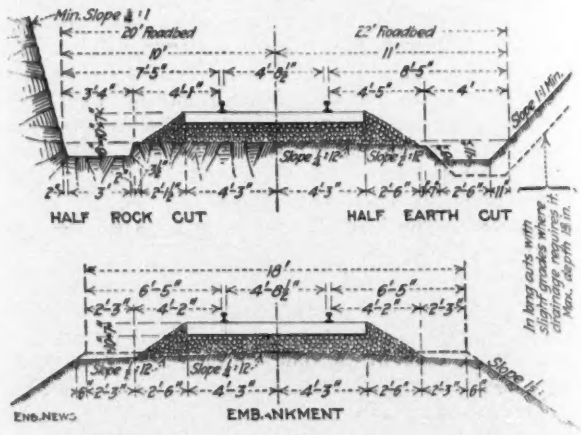

FIG. 10. ROADBED CROSS-SECTIONS OF THE CAROLINA, CLINCHFIELD & OHIO RY.

the completion of the line. Each building is 23½x29½ ft. in plan and has four rooms, with a covered porch along the front and at the rear.

ENGINEERS AND CONTRACTORS

All location and construction work are under the direction of Ward Crosby, Chief Engineer of the Carolina, Clinchfield & Ohio Ry. The writer is office engineer,

and the construction work is divided between six resident engineers. The Rinehart & Dennis Co. has the general contract for grading and masonry, and the American Bridge Co. has the contract for all bridge work.

Unsurfaced Roads*

By W. S. Keller†

Two million one hundred thousand miles of roads in the United States are unsurfaced or rather have not been resurfaced by the hand of man. Until within recent years it was considered next to impossible to make a good road of ordinary earth without surfacing with stone, gravel or other hard material. The absence of suitable material in vast sections of the country and the high cost of it when handled by railroads have forced attention to earth or unsurfaced roads.

Unsurfaced roads may be divided into three classes:

First, the ordinary country road opened when this country was young, leading from one settlement to another or from a farmer's home to that of his nearest neighbor. We have many roads in Alabama now in use that were opened and traveled by General Andrew Jackson, both on his march to fight the British at New Orleans and the Indians in south Alabama and Florida. Of course, such roads were opened hurriedly and little or no attention was given to grades or alignment. In the construction now of more modern roads, it is difficult to better the alignment of these roads on account of homes, churches and schools which have been built close to these highways. However, in many places, these roads have been and are being changed to meet the demand of traffic of today. The genuine bad roads of the South belong solely to this class. The great amount of work necessary to keep them is passable condition disheartens the man who by law is compelled to work them. Until these roads are re-located, avoiding heavy grades and marshy bottoms, sharp angles and useless twists and graded so that they will have good drainage, we may expect them to be bad.

The second class of unsurfaced roads are the ordinary graded earth roads which have proper alignment, grade and drainage. The construction of an earth road is simple, but sometimes the simplicity of it causes the average county commissioner or supervisor to overestimate his ability as a road builder. The proper construction of an earth road consists of first: A careful inspection by the proper official to determine what beneficial changes in grade and alignment can be made, taking into consideration initial cost and cost of maintenance. The center line and grade of the road should be established by an engineer. After the center line has been established and width of roadbed agreed on and grade established, construction work can begin.

The proper and efficient grading force for the work should consist of a foreman, eight or ten good two-horse teams with drivers, one wheel and one drag scraper for horse teams with drivers, one wheel and one drag scraper for each team and one extra wheeler and drag for emergencies, one good railroad grading plow, one grading machine, one split-log drag, one dump man and one loader with five or six extra men for grubbing and other work. The foreman should be an experienced grading man who understands handling earth and knows when it is proper to use drag scrapers, wheel scrapers or wagons.

The road should be so graded that the ditches or gutters are parallel with the center line of the road and a uniform distance from it. When completed the road should be uniform in width and surface should be smooth and even, free from holes and high places with a uniform crown with a fall of one inch to one foot from center to gutters. On grades this ratio of fall should exceed that of the grade to such an extent that water will readily flow to the ditches instead of down the road. Drain pipe should be freely used and no water should be allowed to flow over the road if it can be avoided.

We have in the South nearly every kind of soil from sticky gumbo on the one hand to coarse sand on the other. The methods used for improvement of roads through a section of one will not do altogether for the other. The worst roads by far that we have in the South are in our rich and fertile prairie lands where, unfortunately, there is very little road building material to be found. This soil readily absorbs water and becomes very sticky after rains. It expands freely and dries rapidly when the sun shines and becomes very hard under the tamping effect of teams and vehicles. From observation and experience I have learned that these roads of all others require a very high crown and the driving surface should only be wide enough to allow two vehicles to pass. If a road is narrow with a fall of not less than 1½ in. to the foot, water will shed rapidly to the ditches and the entire surface will dry out rapidly. A road of this kind can be constructed quickly and at little expense with a grading machine, or even with a split-log drag. The latter method will require more time, but in the end will be found to be very satisfactory. No earth road can be maintained in good condition unless it is so constructed as to drain well and unless it is kept free from ruts and holes.

The third class of unsurfaced road which we frequently have to deal with are those in sections of country where the soil or earth is really road building material, composed either of gravel, sand-clay or top soil so that when the road is graded it is, in fact, surfaced. Where this condition exists, splendid roads can be built at a minimum cost.

The maintenance of unsurfaced roads is radically different from the maintenance of surfaced roads. One man with a team and drag should be able to keep in good condition 20 miles of ordinary graded earth road. It has been difficult to convince county authorities in the South that this little machine is of value.

The writer when in charge of road work in a Tennessee County inaugurated a system of dragging that proved very successful. Ten roads were graded a distance of three miles each. The grading was completed in November. With the surface of these roads fresh and loose, it was a foregone conclusion that the winter rains would soften them to the extent that they would become impassable under heavy traffic. Contracts were made with a farmer on each of these roads to keep them dragged during the months of December, January, February and March and the price paid was 30c. an hour for a man and team. The county furnished the drags. As an inducement to the men to do good work, the county offered prizes of $25, $15 and $10 for the best kept roads. Specifications for dragging and rules governing the contest were furnished each contestant. One important rule was that the prizes would be awarded to the men who kept their roads in the best condition at the least cost. In order that the engineer might keep in close touch with the work, postal report cards were furnished each man and they were required to fill them out every Monday showing the distance dragged, hours consumed and cost for the previous week and mail them to the office of the engineer. In this way it was practically impossible for a dishonest man to render an account for more time than he really consumed without it being detected or if he worked more than was necessary, the reports of the other contestants when compared with his disclosed it. On the other hand if one should be neglecting his work by not dragging sufficiently it was likewise detected. This 30 miles of road was kept in splendid condition despite the fact that two heavy snows fell during the four months. The most interesting fact connected with the contest was the road that was awarded first prize cost the county only $15, or $5 per mile, for the winter.

In many Southern States the roads are maintained or at least are supposed to be, by what is known as statute labor, which means a man subject to road tax may work out his tax under the direction of a "beat" or district overseer. Such labor is practically worthless and few men are required to work out the stipulated number of days. As it seems to be impossible to entirely abolish statute labor, the question that confronts us now is, What is the best system coupled with this labor to use in the maintenance of our roads? Good results have been accomplished in several counties in Alabama by putting the work in the hands of a few regularly employed foremen who give all of their time and attention to the work, instead of leaving it to many beat overseers who work when it suits their convenience, or do not work at all when it suits them, as it usually does. These foremen are furnished with two or three teams with regular drivers, wagons, scrapers and grading machines, split-log drag and necessary small tools and as many beats or districts assigned to each as he can work. A census is taken in each foreman's territory at the first of the year of all men subject to road duty and he is furnished with a list of names and is required to work every man who has not paid the required amount of cash into the County Treasury in lieu thereof. No foreman is allowed, under penalty of dismissal, to receive cash from work hands, but such hands as desire to pay must make their pavements to the proper county official at the Court House. This method has proven good in most cases, but as a general thing I do not think the best results can be accomplished by permitting men to work out their road tax.

*Paper before the American Road Congress, Detroit, Mich., Sept. 29-Oct. 4, 1913.

†State Highway Engineer of Alabama.

The Wisconsin Water Power Law

A recent enactment of the Wisconsin Legislature (Chapter 765, Laws of 1913, known as the "Water Power Act") has put all water-power developments (existing and future) in that state under the control of the Railroad Commission, placing them practically on the same plane with public utilities in general. Such widespread interest has been manifested in the new regulations that a brief abstract of the law is given below. The sequence of topics generally follows the law, but the phraseology does not.

The commission is directed (1) to make a complete survey of the navigable waters of the state (with the assistance and coöperation of the state and Federal geological surveys when practicable), (2) to make a complete investigation of all existing dams and franchises, permits, etc., under which they are operated and to report this information to the legislature with recommendations in the public interest, (3) to survey and report on all power sites within the state whether developed or not, (5) to maintain gaging stations on all navigable waters.

No dam can hereafter be constructed unless the commission shall determine that the place is a suitable power site and that the work proposed will not interfere with any other dams authorized for river improvement. The improvement of river navigation, the construction, maintenance and use of all dams, and control of river level and flow are placed under the supervision of the commission. The commission is to determine reasonable methods of construction, equipment, maintenance and operation of any improvement, and no dam can be constructed until plans and specifications have been approved by the commission. Except in emergency (protection of life, health or property), no substantial alterations or additions can be made to any dam without an investigation and order of the commission. On complaint or on its own motion, the commission may examine any dam, structure or reservoir, and, if one is found, unsafe, it must determine what work is necessary, and it may order such work done. In cases of emergency the commission may, without notice, cause any stored water to be drawn out.

The act provides that all dams in navigable waters must conserve and protect navigability. The commission is directed to require timber slides, locks, boat hoists or marine railways, spillways or flood gates, protecting booms or piers, and benchmarks showing allowable minimum and maximum heights of water level. Every dam owner, except a municipality, must pay an annual inspection fee of 10c. per horsepower storage capacity at ordinary stages (with a minimum of $10). Corporations holding a franchise under the new law are subject to the duties and liabilities of river-improvement companies under the general law but are entitled to reasonable tolls for navigation facilities. The tolls are subject to commission regulation like public-utility rates.

No person, firm, corporation or municipality may hereafter use a dam across any navigable stream without authority of law, legislative act, or a franchise under this act. Franchises authorizing the construction, maintenance and use of dams, where not more than 250 hp. can be developed, and dams for improving navigation, may be granted to any person, firm or corporation, or to any municipality. But franchises covering sites where over 250 hp. can be developed may be granted only to corporations or municipalities.

Applicants must file a description of the power site and proposed dam, show the extent and method of navigation improvement, list all riparian owners affected, name the nearest city above and below the site, and the nearest dam existing above and below, present a large-scale map of the power site and all lands affected, state the amount of power proposed to be generated, and describe the market territory. The applicant must propose (1) fully to develop the available water power and to install such auxiliary power as the commission finds advisable, (2) to install a prescribed system of accounting and authorize the commission to audit revenues and to approve expenditures for construction, (3) to terminate contracts, not more than 30 years after the franchise date, giving the commission right then to require that power delivered to distant points be furnished to nearer points, (4) to give the state right after 30 years to collect a specific amount per horsepower developed, provided the state have constitutional power to, and shall engage in improvement of navigation, (5) to sell its property at reproduction cost to a municipality or to the state if it then have constitutional power to purchase.

On receipt of an application the commission is directed to give a public hearing advertised for three weeks. The applicants are required to notify every person interested in affected lands. On notice of favorable action upon an application, articles of incorporation are to be filed with the commission. These papers are to be approved and filed with the secretary of state. Incorporating power formerly vested in this officer is transferred to the commission so far as concerns water-power and river-improvement concerns.

A franchise will continue in force until the state or municipality exercises its option to acquire the property in which case both corporate charter and franchise terminate. When such property is acquired just compensation must not include any value for the franchise. The law specifically denies the existence of any private property right in water or the use of water, and permits no state agency to pay compensation for value of any power site because of water power or the use of water power. Property located within or without the corporate limits of a municipality may be acquired for public municipal purposes after condemnation proceedings. When a state or municipality exercises its option to purchase, it is required to give existing customers preferential rights to service; but such right shall not continue more than 10 years.

If a grantee, having a dam of less than 250-hp. capacity, desires to increase it over that figure or shall desire to couple up that with any other developed water power to complete a development of more than 250 hp., application must be made for a charter and franchise as for the larger developments. No transfer or assignment of franchise is valid unless the commission shall approve it, and no franchise can be assigned to foreign corporations. A franchise granted to a municipality cannot be assigned to any person, firm or corporation except as security for a loan, and the latter may hold title or operate only three years. No municipality may execute a lease or contract for the sale and use of power for periods longer than 15 years, and only on the approval of the commission.

If any improvement under this statute shall be owned, leased or controlled in any way so as to effect an unlawful combination or a restraint of trade in the sale of power, then the commission may take possession of the property by receivership proceedings, the members of the commission being appointed as receivers for such period as the courts may determine.

Violations of this law are punishable by forfeiture of up to $1000 for each violation. A sufficient sum is directed to be annually appropriated out of money in the treasury sufficient to carry out the provisions of the act but not to exceed $25,000.

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The Australian Circumcontinental Railway, which is eventually to run from Kalgoorlie, in Western Australia (at which point it connects with a railway already built to the western coast at Perth) to Port Augusta, on the southern coast in South Australia, is now under construction. This line has been under discussion in Australia for many years (see "Engineering News," Jan. 5, 1905, July 30, 1908, Jan. 6, 1910). According to a note in the engineering supplement of the London "Times," the road was started during 1912, and the rails have now been laid for a distance of some 10 miles from each end. Construction had, however, been delayed, by the non-delivery of rolling stock. It is intended to use track-laying machines and other labor saving devices in the construction of the line, as considerable difficulty is anticipated in obtaining suitable labor. What there is, is very expensive. Owing to the poor nature of the country, little local traffic is expected, but there will be a large passenger and mail traffic between the eastern and western states. From the point of view of defense, according to the "Times," the railway is essential, as at present all communication between Eastern and Western Australia would be cut off if command of the sea were lost. The total length of the Transcontinental Railway will be 1063 miles. The gage is to be the standard, 4 ft. 8½ in.

The following table is given in the "Times" to show the state of railway construction in Australia at the present time.

Name of state or country	Railways open for public traffic owned by government	Population	Miles of railway per 10,000 inhabitants
New South Wales	3,831	1,737,335	22.06
Victoria	3,622	1,354,405	26.74
Queensland	4,266	633,917	67.30
South Australia	1,461	420,806	46.09
	478	.....	.....
Northern Territory	145	3,302	.....
Western Australia	2,598	302,341	85.94
Tasmania	495	190,017	26.06
Commonwealth of Australia	16,899	4,644,239	36.39

* Port Augusta-Oodnadatta line transferred to Commonwealth.

EDITORIALS

Excess Condemnation to be Voted on in New York State

City engineers and many other city officials as well have often observed the embarassment and economic loss caused to cities in condemning real estate for street and other public improvements through the cities being limited to the taking of only the area required for the purpose in hand, regardless of the shape and size of either the portion of any given lot which is taken or of that which is left. As a consequence of this restriction, which is almost, if not quite, universal in the United States, our cities often have to pay the full value of a lot for only a portion of it, and sometimes a small portion at that.

In sharp contrast to this requirement, European cities are quite generally allowed to take land outside the area to be devoted to public use, and subsequently to rearrange the remaining odd-shaped parcels in accordance with a well devised plan and sell the land with suitable restrictions on the character of the buildings to be erected upon it. As a result of this foreign plan, substantial savings are effected in the cost of land, and sometimes a profit through appreciation in value due to the city improvement—that is, the city gets for itself the unearned increment which its action alone has created.

The practice of taking more land than is needed for a public improvement is known as "excess condemnation." A constitutional amendment authorizing that practice in New York State was passed by the legislatures of 1912 and 1913 and now requires only the sanction of the voters of the state at the coming election on Nov. 4. It is to be hoped that the vote will be favorable and that like constitutional amendments will be adopted in other states where like authority does not exist.

⁂

The Flooding of Culebra Cut on the Panama Canal

Since the most gigantic task in connection with the Panama Canal work has been the excavation of the nine-mile long Culebra cut through the Continental divide, so the most notable landmark in connection with the gradual completion of this greatest of engineering works, was without doubt the flooding of the Culebra cut excavation on Oct. 10.

As our readers who have followed the progress of the work are well aware, all the excavation work on the canal through Culebra cut has up to this time been done in the dry by steam shovels. The cut has been drained by gravity to the east and to the west as the work proceeded; and at its eastern end a dike across the channel at Gamboa has prevented the flood waters of the Chagres River, and within recent months the rising waters in Gatun Lake, from flowing into the cut. As the level has been gradually lowered by excavation it has been necessary to use pumps to lift the drainage water from the cut over the Gamboa dike.

On Oct. 1 the valves in the four 24-in. drainage pipes through the Gamboa dike, into which the pumps discharged, were opened and the waters of Gatun Lake were allowed to flow through the pipes into the cut for ten days. On Oct. 10 a charge of forty tons of dynamite, distributed in holes along the length of Gamboa dike, was set off, the initial electric impulse causing the explosion originating in an electric push button installed in the offices of President Wilson, at Washington, D. C. By special connections of land and submarine telegraph, this impulse was transmitted the entire distance from Washington to Panama, to set flowing the current which discharged the great blast.

While a certain amount of excavation remains to be done in the cut by dredging, it may fairly be considered that the present flooding of the cut, which for the first time establishes a navigable channel across the Continental divide, is the most conspicuous landmark in the completion of the work.

The only feature for regret in connection with this notable occasion is that the engineer who has been most closely identified with the Culebra work for the past half-dozen years, Col. D. Du B. Gaillard, who has been seriously ill for three months past, could not be present to witness this culminating event of the great task. Engineers who have visited the Panama work appreciate the extent to which Col. Gaillard's energy and ability have been devoted to the monumental work at Culebra; and the honor attaching to its successful prosecution is certainly his.

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The Loss of the "Volturno," and Lifeboat Equipment of Ships

The worst marine disaster on record since the loss of the "Titanic" was the burning of the Uranium Line steamship "Volturno" at sea, on Oct. 9, with the loss of 150 or more of her passengers and crew, and the fortunate rescue of the remainder by ten transatlantic steamships, summoned to the aid of the doomed vessel by wireless telegraph.

The circumstances in connection with the "Volturno's" loss bring out prominently the fact to which frequent reference has been made in these columns, that the circumstances of the "Titanic" disaster have caused far too much emphasis to be laid upon the lifeboat equipment of ships. The chief loss of life on board the "Volturno" was among those who left the ship in lifeboats as soon as the fire became threatening, which boats were doubtless carried away and swamped in the high seas prevailing at the time. Those who remained on board until the storm abated were rescued by the surrounding steamers before the fire reached them.

It was indeed pointed out at the time of the "Titanic's" loss, that under the weather conditions which prevail a

large part of the time on the North Atlantic, the launching of a lifeboat and filling it with passengers from a large steamer is fraught with serious peril. It is impossible for such a boat to float long without swamping, and the process of taking such a boat and passengers on board a rescuing vessel is even more dangerous than the launching. These facts are all perfectly well known by those familiar with sea conditions; but to the general public the spectacle of the "Carmania," the first rescuing ship to reach the "Volturno," standing by for 24 hours unable to rescue one of the passengers on the burning steamer, only a few hundred feet away, is a vivid revelation of the limitations of lifeboat work on the North Atlantic.

As has been previously pointed out in these columns, in order to effect the greatest improvement in safety at sea emphasis ought to be laid on fireproof ship construction and methods of retarding the spread of flames, rather than overloading ships with lifeboats, which may even under some circumstances promote the spread of the flames over the upper decks.

The disastrous fire at the North German Lloyd piers and the steamships lying beside them, at Hoboken, N. J., in 1900, and the severe fire on board the "Imperator" while lying at her Hoboken pier this summer are illustrations of the extent to which the fire danger on board ships is very real and very serious. The burning of the "Volturno" may well turn the attention of the International Conference on safety of ships at sea toward better methods of ship construction to limit the spread of flames.

De-Centralizing Great Organizations

We have noted in these columns from time to time the work which has been done in some of the larger railway, industrial and government organizations, toward de-centralizing the control and management. It is agreed by most of those who have closely followed the progress of consolidation in industrial organizations, that in many cases it has gone too far, and a serious loss in efficiency has resulted. There is no doubt that production on a large scale has great advantages in point of economy over small-scale production, but there are many instances where a great organization has outgrown the capacity of the men at the head to efficiently and economically supervise its operations.

The latest example of de-centralization is furnished by the New York, New Haven & Hartford Railroad Co., whose Board of Directors on Oct. 3 adopted resolutions, declaring their intention to radically revise their organization, providing a separate president and executive staff for the Boston & Maine system, for the New York, Ontario & Western R.R., and for the New Haven system. Similar action is announced as decided upon, as soon as practicable, with reference to the street-railway lines and steamship lines controlled by the New Haven company. While this action is taken under the spur of the recent condemnatory report of the Interstate Commerce Commission upon the New Haven system, there can be little doubt that the directors are convinced, by the logic of events, as well as by public criticism, that their policy of centralization has been carried too far.

One paragraph of the resolutions adopted by the Board is especially significant. We quote as follows:

> In addition to taking these steps, action has been taken about reducing the size of the operating divisions on the New Haven Road so as to make certain that superintendents are not overburdened, and therefore unable to give thorough attention to safe and economical operation, and unable to keep in touch with the employees and the public.

It is pretty well known that a large proportion, at least, of railway operating officers are overworked. That is to say, their routine duties take up so much of their time that they have little strength or leisure left to carry out two important lines of work which they should not neglect; to wit, cultivating closer personal acquaintance with the men of their operating force, and also with the men of influence and position in the communities which they serve.

One result of the current craze for efficiency, as represented in low cost figures, has been the attempt to make an economical showing by cutting down the number of supervising officials as fast as consolidations were effected. In this way, it has not seldom happened that one man has been set to do the work which two men did before. The result in too many cases has been either a nervous breakdown or the shoving aside of such work as would suffer least by neglect. In many cases the neglect has cost the company, in the long run, many times the amount of the salary saved.

Reforms Needed in Parcel-Post Administration

One of the well known defects in governmental execution of business affairs is that when a task is to be undertaken sufficient time for proper preparation is seldom allowed. For years Congress has had before it the question of establishing a parcel post, and there is no doubt that had businesslike methods prevailed in Government administration it would have been established long ago. When Congress finally acted, however, it ordered the Post Office Department to undertake the carriage of parcels on very short notice. Congress itself might dilly-dally over the matter for years; but when it had once acted it demanded results at once, without any comprehension of the fact that to build up an efficient organization to carry out a great task is a work which demands months and years. The public, therefore, should, and we believe does, make large allowances for the present glaring defects in the administration of the parcel-post service. Nevertheless, it is proper that some of the notable defects should be pointed out.

One of these is the remarkable jump in the rate between the second zone and the third zone. On all parcels above three pounds in weight the charge for the third zone is three or four times what it is for the second zone. For example, for a 10-lb. package sent a distance of 50 to 150 miles the rate by parcel post is only 14c.; but as soon as the 150-mile limit is passed the rate jumps to 52c. The increases for the zones beyond the third zone are moderate and reasonable.

It may be said, of course, that this discrepancy has arisen through the lowering of the rates in the second zone (50 to 150 miles) so that they are no greater than the rates in the first zone; but this explanation does not excuse the discrepancy. If the rates are to be based on the cost of carriage according to the distance, they should conform to that "rule of reason" which the Supreme Court has lately emphasized. The government is strenuously and properly demanding that all rates charged by the railways shall be reasonable. When it goes into the

transportation business itself, it is bound to do what it requires of others.

A still more serious defect in the parcel-post administration and one which is far harder to remedy is the rough handling which parcels receive. Apparently, the government officials have attempted to carry on the parcel post in the same manner that they carried merchandise before the parcel post was established; that is, by promiscuous dumping into heavy bags of all sorts of parcels indiscriminately. The natural result, of course, is that only heavy articles or those most substantially packed survive. Fragile parcels subjected to this sort of "rattler" test arrive at their destination, if they arrive at all, badly injured or ruined.

The public has been told repeatedly that the parcel post was to relieve the public from the extortions of the express companies, and many comparisons have been made between the parcel-post rates and express rates. Express companies, however, are responsible for the safe carriage of the goods which they handle; and they have learned by long years of experience how to handle even the most fragile packages so that they arrive safely at destination. If the express business were to be carried on for one day as the parcel post is now carried on, the claim departments would be swamped with business enough to last them a year.

It is evident that if the parcel post is to be carried on as at present, its use will soon be confined to that class of merchandise shipments which can stand rough handling without injury; and all other classes of goods will continue to be handled by the express companies. Such a program, however, will fall far short of meeting public expectations. If the government is to undertake the carriage of small parcels as part of the post-office business, it should do as other governments have done and establish a system by which such parcels can be transported with at least reasonable safety against damage.

Starting the Work of Flood Protection

The problem of flood protection in the Central States, to prevent the recurrence of disasters like that of last March, comes into prominent view through four reports appearing almost simultaneously—that of the special board of Army Engineers, that of the Geological Survey, and the two reports of consulting engineers on protective works for the cities of Columbus and Dayton. (A report for the city of Lima, Ohio, has been received since this was put in type.)

The Army Engineers' report, a very interesting document, is rather obscure in one point, and may mislead those who have not followed the stream-control situation. Both from the Board's report and from the memorandum of the Chief of Engineers the reader might conclude that the War Department has in the past exercised control over navigable rivers in their entirety. That is by no means the case. In the first place, not all navigable rivers have been controlled (or supervised, or even studied) by the Army Engineers, but only those rivers *which have been declared navigable.* In the second place, even such rivers have not been controlled in their entirety, but the control has been carefully confined to the *navigable channel,* or better the low-water width; the public's interests in the valley outside of this width have not been recognized, except on the Mississippi and some of its tributaries.

For example, the present experience shows, by the testimony of the Army Engineer Board itself, that railway embankments across valleys outside the low-water width may be harmful to the general interest. When in the past a railway prepared to build a crossing over a navigable river, and submitted its plans to the War Department for approval, the department took jurisdiction of the channel bridge alone, and paid no attention to the embankments or trestles connecting the bridge with the valley sides.

This condition of affairs, which is not hinted at in the Board's report, is one of the two reasons why the flood plains of rivers have been a no-man's land. The other reason is to be found in the fact that State legislatures did not assert control over the flood plains when the representatives of Federal authority thus disclaimed Federal control. Congress also permitted the situation to remain chaotic.

The War Department doubtless had good grounds for being thus backward about taking authority over more than the strict field outlined by statute. And yet it is extremely unfortunate, we now can see, that the Department took this attitude. Other bureaus of the Federal government have been less scrupulous; on their own initiative they developed their sphere of action far beyond the limits of their instructions. So for example the Geological Survey, under the caption of water-supply studies, tackled some problems of river flow and flood prevention years ago; and, still extending its field in the same direction, it now issues a lengthy report on the floods of last March, also under the cloak of water-supply studies. Had the Army Engineers in past years displayed similar aggressiveness to push boldly out from the limits of their specific instructions into correlated fields of work, we might long ago have had the various existing defects of river-valley administration brought to public attention.

As matters stand now, the Army Engineers make a distinct claim—for the first time—that full-width control not only of navigable rivers, but also of their branches, is a necessary part of navigation control. They also imply that the future Federal flood-prevention work should be in the hands of the War Department exclusively. But on the other hand the Geological Survey also claims part of this work, if we read correctly between the lines. We hope it will not develop into a situation on which rival Federal bureaus will plan and construct different river works in a single stream valley.

That Federal flood-prevention should be mentioned primarily and nothing said of State or community work may appear strange; but there is no doubt that the inhabitants of the flood districts are looking toward the pouring out of national funds to protect them. There is a very neat passage in the Geological Survey report which indicates that Messrs. Horton and Jackson also thought mainly of work by the Federal Government:

> Thus, with the added possibility of floods of greater magnitude than have ever occurred in the past, it would seem wise and proper that a generous interpretation should be placed upon the amount of money to be expended for purposes of flood control in the Ohio Valley.

If the words "wise" and "generous" in this passage do not refer to the patriarchal mind and openhanded philanthropy of Uncle Sam, we miss our guess.

The great need of the case, that the river-valley com-

munities should band themselves together in associations for joint planning and building of protective works, under the ægis of State legislation, is in danger of being pushed to the background by this emphasis on Federal work. A valuable half-year, since the great floods, has been lost without much progress toward confederation of this kind. The first urgings in the proper direction appear in the consulting engineers' reports to Columbus and Dayton. It is to be hoped that they will bear fruit in the very near future.

These two reports—by Alvord & Burdick on Columbus, and by the Morgan Engineering Co. on Dayton—present a curious contrast in their recommendations. The former lays stress on river-channel enlargement, while the latter virtually discards channel work and makes strong advocacy of exclusive storage-reservoir construction. The physical conditions at the two cities are different, of course. At Dayton any diversion or river-correction work would have to be much more radical than at Columbus. Yet the river conditions at Dayton are fully as bad and require amelioration as urgently as anywhere along either the Scioto or Miami. Possibly the Dayton engineers realized, however, that plans requiring radical alteration in the city itself would have to meet the least bulk of inertia which a community can bring to bear, whereas most citizens would favor a scheme whose ideal is the complete subjugation of the river while placing the inconvenience on outside districts rather than city territory.

The largest river in Ohio, the Muskingum, is still to be heard from. If the Miami requires six reservoirs to control it, the four or five times greater Muskingum may need a dozen or twenty. In the carrying out of such extensive and important improvements the state itself ought to play an important part. The Ohio situation is difficult enough to call for the best and broadest planning.

LETTERS TO THE EDITOR

A Fraternal American Engineering Society

Sir—The statement in the editorial on p. 369 of ENGINEERING NEWS, Aug. 21, that Great Britain has in the Junior Institution of Engineers a society which has no counterpart in this country, should not be permitted to pass without correction. America has a national society which, as far as one may judge from the editorial referred to, is identical both in aims and methods with the Junior Institution. This is the American Society of Engineer Draftsmen.

In the matter of name and age only there appear to be essential differences between the two associations, for while the Junior Institution is stated to have been established "many years" [29 years], the American Society of Engineer Draftsmen is only a baby in the engineering world. It can justly claim, however, to be a very lusty infant.

The American Society of Engineer Draftsmen, although it has not existed long enough to have permitted its early members to reach top-notch positions, has, nevertheless, among its members men in top-notch positions, some of whom are members of the leading engineering societies of this country. These men joined the Society on account of their sympathy with the objects of the association and their belief in the necessity and usefulness of such an organization for the junior engineers of America. The President of the Society is Prof. Chas. Wm. Weick, M. Am. Soc. M. E., head of the Department of Mechanical Drawing in Teachers College, Columbia University.

Among the forces which compelled the formation of the Junior Institution of Engineers and the American Society of Engineering Draftsmen are: the fierce competition for employment among junior engineers; the poor remuneration (considering the time and money spent on education) resulting from this competition; the utter chaos which exists in the engineering world in the matter of placing a man in a position where his ability can be used to the greatest advantage, and the fact that the established engineering societies are formed "to advance engineering and science," and that they do not consider the individual further than to induce "social intercourse."

Your correspondent of Jan. 2, 1913, whom you quote, appears to have had some conception of these conditions and proceeded to put it up to his society to rectify them. The American Society of Civil Engineers is not rectifying them, however, for the reason that the time has not yet arrived when the forces which control that organization (rich and influential as it may be) work in that direction. The force which will compel this or any of the other large societies to act in that direction is the force of public opinion; and public opinion has not yet decided that the human side in engineering is paramount to the scientific; and until that time comes there is need as your correspondent says, for a new organization. That new organization, which is rapidly developing, is the American Society of Engineer Draftsmen.

Some idea of the great need of the new organization may be gained from the fact that if we combine the membership of the 200-odd societies given in the ENGINEERING NEWS directory of August, 1911, with the exception of the Stationary Engineers, we have not half the estimated number of men engaged in the profession of engineering.

For more than two out of the three years it has been in existence the American Society of Engineer Draftsmen has held regular monthly meetings at which have been read original papers by members and lectures given by speakers of the highest order, whose services have been placed at the disposal of the Society through the active influence of its President. An abstract of one of these lectures (by Dr. F. R. Hutton) may be found in ENGINEERING NEWS of Jan. 13, 1913.

By way of exemplifying the field there is for such an

organization, it may be stated that the Society holds the record for rapid increase of growth in attendance at meetings in the Engineering Societies' Building (New York City), where a careful check is kept on the attendances of all the engineering societies meeting there.

Considerable publication work has already been done, the first action in this direction being the publication of the papers read by members. This was immediately followed up by an Employment Bulletin and Data Cards. Then came a small sheet carrying Society news, and this has now been superseded by a regular monthly *Journal*, which contains a Society article outlining the progress being made; papers and lectures; a correspondence column which forms an open forum for discussions of interest to members; extracts from technical magazines which may be considered of special interest to the fraternity, lists of new members elected each month and committee and branch Society notices.

The primary importance of an active Employment Department was recognized from an early date and an immense amount of successful work has been done in this connection. The first step was to let employers know that a clearing house had been established and then the problem of bringing the vacancies to the attention of members was solved by issuing an Employment Bulletin.

This Bulletin shows, at a glance, the nature of the work to be done, whether the position is permanent or temporary, the range of salary offered, the working hours in the office, whether traveling expenses will be paid and the locality.

As an instance of the cordial relations which exist between employers and the Society it may be stated that many of the largest employers of draftsmen in New York City post from one to six notices of the regular monthly meetings in their drafting rooms. Several of the technical colleges also post notices of the meetings and the employment bulletins, which are of great interest to men who are nearly completing their courses and those who work during the day and take night courses.

From the early experiences of the Employment Department it became apparent that classification lists, both of members and employers, would have to be maintained. This work called forth another display of the loyalty and determination of the members, for an Employment Committee was formed and as a result of its untiring efforts, service record sheets have been obtained from all interested members, and from these sheets complete classification lists of members have been developed for each branch of engineering.

The result of this work is that if an employer writes in for a man experienced in a certain line of work, each member having that experience can be immediately located and the degree of experience he has had be determined at the same time, so that a $50 a week man would not be sent to seek a position offering $20 or *vice versa*. As an additional assistance out-of-work cards have been prepared so that such names may be kept in the foreground; and then to make records complete each man who is placed fills out another card giving all particulars of his contract. The classification lists of employers show the nature of the work they do, the number of men of each grade employed and other particulars of interest and importance.

The junior American engineer, therefore, does not stand in need of any commiseration when he has an institution right at hand laid on such a thorough foundation as to build an organization which need take second place to none having similar aims. From the rapid growth which has already been made it is sufficiently evident that the junior engineer knows that only an organization which is going to study his interests, or as your editorial says, discuss the problems affecting the human side of engineering, is going to be of real worth to him.

Your editorial states that "many of the younger members of the profession are becoming restless and dissatisfied with the attitude of those who control the work and activities of the engineering societies." If this is the case, it can only be attributed to the ignorance of the junior members of the declared aims of the engineering societies, which are, in general, to advance science and engineering.

Before the large societies can effectively face the problems affecting the human side of engineering, they will be obliged to modify their declarations of aims and purposes; and before they can hope to do that the shining lights of the profession will have to be shown wherein lies the brotherhood and community of interest between themselves and the little fellows.

Until this time comes to pass there is only one way to allay what you term the restlessness and dissatisfaction of the younger members of the profession and at the same time save them from what you designate "the secret agitation for labor union methods of improving the condition of young engineers." That way is the method adopted by the Junior Institution of Engineers and the American Society of Engineer Draftsmen.

WALTER M. SMYTH,
Sec'y American Society of Engineer Draftsmen.
74 Cortlandt St., New York City.

The Crown Suitable for Bituminous Macadam Pavements

Sir—Referring to the excellent paper presented before the International Road Congress on "Causes of Wear and Deterioration of Roadways," by L. J. Hewes, reprinted in the Sept. 25 issue of ENGINEERING NEWS, I wish to call attention to the error that is frequently made in tar-macadam roads by adopting too high a crown. It is common to use the same crown that has been found best for water-bound macadam; and in changing from one pavement to the other it is convenient to retain the same crown because of the expense of changing manhole covers, curbs and other roadway structures.

Where the crown is high the slope near the gutters is so steep that the bituminous material draws into the gutters in warm weather. This not only makes trouble by its presence as a sticky mass, but it drains the necessary binder from the central portion of the roadway, rendering the surface liable to ravel when the temperature drops.

The object of a crown is to draw surface water to the gutters. The surface of a tar-macadam pavement is so smooth that very little inclination is needed for this purpose and probably 2 in. is enough for this kind of pavement where 6 in. would be needed for water-bound macadam. Steep side slopes of smooth pavement are objectionable also from causing automobiles to skid dangerously.

I think this feature of proper crown for roadways of different kinds of surfacing should be gone into much more fully than it has been in recent literature, so far as I have noticed.

J. P. SNOW.

18 Tremont St., Boston, Mass., Oct. 4, 1913.

On the Value of Membership in the American Society of Civil Engineers

Sir—The letter of H. B. Kirkpatrick in your issue of Sept. 11, 1913, p. 524, brings up several points meriting discussion.

Primarily, what is the American Society of Civil Engineers? It is *not* a club. That is perhaps the first mistake Mr. Kirkpatrick made on his trip to New York. It should not be a club and probably never will be a club.

The Society is a body of over 7000 men scattered all over this globe—a ponderous body to be sure. It is inconceivable that the work incident to preparing the publications, sending out of notices, etc., for such a large body should be done gratis. Hence, somebody has to be hired and paid to do it. If they get their living that way, all well and good, so long as the work is well done.

If Mr. Kirkpatrick feels that his money is not well invested he might well resign; but it would be wiser first to try to change his attitude toward the world in general, for running all through his letter is an undertone of pessimism of the worst sort—the kind of pessimism which makes men sit back and grumble because the world doesn't bow at their feet and beg for a chance to serve *them*.

The world is too busy about its own business, my brother. If you want it to serve you, you must whip it into obedience. You will wake up some day and, like the rest of us, find you are whipping yourself; for every man is his own world, and he gets out of it only what he gives himself. Some of us can't give ourselves much; but we were born that way. A careful perusal and study of President Swain's address before the Society at the recent convention in Ottawa will do us all good.

The Society is not a man nor a thing with the power to please all its members. The Society is a body of 7000 men, each one having an active part to play. Offhand, I should say that $\frac{6999}{7000}$ of the Society have naturally more to do with shaping its policies than $\frac{1}{7000}$ of the Society. This means that things will go on as they have been in the past unless more than one member undertakes to make a change.

I am not at all of the opinion that the one member is entirely wrong in his views, but I am of the opinion that he cannot sit back and say, "let the Society wake up and do thus and so," when he is a part of that Society, unless he himself wakes up, and wakes up a sufficient number of members to put the change through.

I, too, wear a pin. I have worn it for ten years. But I never had an idea that the pin would get me a job. It probably is used often enough as a shield behind which certain members try to hide the inexperience or incompetency that shows only too plainly on their faces or in their past work. This in itself is a valid reason why the Society should not assume any responsibility for its members. If Mr. Kirkpatrick thinks it over I believe he will come to the same conclusion.

I am willing to concede that a great part of the 7000 members are wiser men than I. Further, I give them credit for being interested in the welfare of the Society and I believe they are working for its good and for the good of the individual member.

The Society is naturally unwieldy and it will take time to make it perfect. At best the Society will not please all. We shall have to adjust ourselves to it. We need patience and perseverance. The formation of local associations of members is a step in the right direction, and the movement is gaining ground.

At one of these associations where I am privileged to meet my fellow engineers socially at the lunch table as in a club, I feel perfectly free to discuss such problems as the betterment of the parent society.

It is more loyal to discuss such matters there than in the columns of ENGINEERING NEWS, not all the readers of which are members of the American Society of Civil Engineers; and surely disloyalty will never help to bring about the desired end.

If there is no such local branch at Evanston, Ill., I would suggest to Mr. Kirkpatrick that he at once organize one. It will do him good to talk over "family" affairs where they should be talked over—in the "family."

Membership in the American Society of Civil Engineers is a privilege and an oportunity. Make of it what you will, each according to his ability.

"BROTHER."

Seven Principles for Increasing the Efficiency of Municipal Officials

Sir—Working in conjunction with the National Municipal League on the problem of increasing the efficiency of municipal officials, a problem of obvious and deep importance to many engineers, the following Seven Principles have been formulated:

(1) Elimination of all considerations in the selection of all administrative officers (or members of the "operating" departments), except fitness, as determined by individual aptitude, training and practical experience.

(2) Perfection of methods of determining fitness of administrative officials, especially those of the higher executive class.

(3) Elimination of the residence requirement for all nonpolitical officers.

(4) Assurance of proper authority to qualified public servants in the exercise of administrative duties.

(5) Assurance of permanency of tenure promotion, and adequate compensation for satisfactory service.

(6) Expansion of the facilities for securing scientific information on all phases of municipal activities (Municipal Reference Libraries).

(7) Establishment of more adequate means for the training of men for administrative service, especially in its higher grades.

Those who are trying to improve municipal administration would be helped by expressions of opinion from engineers and others in the technical branches of municipal work as to the soundness of these principles. Suggestions regarding (2) and (7) would be particularly welcome.

H. S. GILBERTSON,
Executive Secy., National Short Ballot Organization.
383 Fourth Ave., New York City, Oct. 4, 1913.

Preliminary Report on Dayton Flood Protection

Following the report by Alvord & Burdick on flood protection for Columbus, Ohio, summarized in ENGINEERING NEWS three weeks ago (Sept. 25, 1913, p. 631), a report on flood protection for Dayton, Ohio, has just been made by the Morgan Engineering Co., of Memphis, Tenn. This concern was engaged by the Dayton Citizens Relief Commission last April. The commission apparently went beyond the thought of Dayton alone, as it included in its instructions to the Morgan Engineering Co. (for surveys and plans on flood protection) the whole Miami River valley north of the south line of Montgomery County, including the cities of Miamisburg, Dayton, Troy and Piqua. The instructions covered not only flood protection of cities but also reclamation of agricultural lands in this district.

The present report of the Morgan Engineering Co. is only a preliminary memorandum. It states very summarily the views and findings which the engineers have reached up to now. The engineers state that they have given consideration to all methods which have been proposed or which could be devised. This included even several projects for diverting one or more of the rivers at Dayton (the Miami, Stillwater and Mad Rivers) around the city by channels through the upland; but the engineers condemn these as entirely impracticable.

The projects which are discussed favorably are of three kinds: diversion projects, channel enlargement projects and reservoir-storage projects. The third class includes only the pure storage plan, as projects in which storage is combined with diversion or channel-improvement are included in the first two classes. No estimates of cost for any of these projects are presented, but certain expressions of favor are made on general principles.

Slightly condensing the company's statement of the nature of the several projects, they are as follows:

Diversion Projects

(1) Two storage reservoirs on the Stillwater River with the diversion of Mad River through the city along or near the route of the old Miami and Erie Canal and the improvement of the present channel to carry only the Miami River.

(2) Two storage reservoirs on the Stillwater River with the diversion of the Miami River just north of the city southward to a point east of the gas works, and then the diversion of both the Mad and Miami Rivers south along the old Miami and Erie Canal crossing the present course of the Miami River above the Stewart St. bridge, and thence southwesterly two miles or more.

(3) Diversion of the Mad River into the Miami and Stillwater north of town and the diversion of all three streams from a point near the Steele Dam southwesterly along the Old Miami Boulevard into the river near the Dayton View bridge; thence following the present course of the river to the mouth of Wolf Creek and thence southwesterly to the southern limits of the city and beyond.

Channel Enlargement Projects

(4) Improvement of the river channels throughout the city; removing all of the concrete bridges and replacing them with steel truss bridges with not more than two piers in the channel.

(5) Improvement of the river channels leaving the concrete bridges in the channels, but deepening their foundations from 10 to 20 ft.

(6) Straightening the Miami River channel by rounding off some of the sharpest bends and at the same time increasing its size.

(7) Raising the levees. In the plans heretofore mentioned it is intended to keep the water line below the present top of the levees. Raising the levees, improving the channel and lifting the concrete bridges to higher elevation is feasible, but would have the disadvantage that street grades approaching the bridges would be steeper, that the higher stage of water during a flood would tend to be a menace to the city and that higher levees would be a detriment to adjoining property.

Storage Project

(8) Two reservoirs on the Stillwater River, two on the Miami River, one on Loramie Creek and one on Mad River. The extreme flood flow at Dayton would be reduced to not more than one-fifth and at Hamilton to about one-third of the greatest flow during the flood of March, 1913.

The engineers discuss the difficulty of planning channel-improvement schemes on account of our imperfect knowledge of the hydraulic principles of river flow, in the following paragraph:

The projects for the improvement of the present river channel are the most difficult to deal with because of the bridges; of the tendency of the water to pile up at the outside of the bends in passing around the bends; of the necessity for paving the sides and part of the bottom of the channel with concrete to prevent the erosion which would result from high velocities, and especially the great loss of velocity at the bends in the river. In so crooked a river as the Miami and with so high velocities as we would have, the loss of velocity due to bends in the channel is one of the controlling conditions. The engineering principles underlying this point have never been well worked out, and we must give them very careful investigation in plans for channel improvement.

We know, however, that with the river channel improved but not straightened the water during extreme floods would be 10 to 15 ft. higher at the Herman Ave. bridge than it would be if the river were straight. If the bridge openings were left in their present condition except for protection to the piers, the water level at the Herman Ave. bridge would be more than 10 ft. higher than if there were no bridges to obstruct its flow. These few figures are given only to indicate the difficulties of the problems encountered in planning the improvement of the river channels.

The present river channel, with the water flowing at the top of the levees, would carry less than half of the flood of last March.

The engineers fail to comment on diversion or channel-improvement schemes. On the other hand, they comment at considerable length on the storage-reservoir scheme, and this comment is favorable, almost glowing.

At the time we began our investigations we did not believe that complete flood protection could be secured by storage reservoirs, and our investigation of this means of river control was carried out chiefly because it has been our policy to examine carefully every possible method of improvement. We find upon examination that due to the alternate widening and narrowing of the valleys of the Miami, Mad and Stillwater Rivers they are peculiarly adapted to the construction of reservoirs. We have investigated all of the more practicable sites over the watershed and have determined upon six which fully meet the requirements.

We have not completed estimates for any other methods of improvement, but have progressed far enough to make reasonably certain that if all the interests which are affected bear their proportions of the cost, flood protection for the Miami Valley can be secured by a system of storage reservoirs more cheaply and more quickly than by any other method. We have outlined a system which will give complete relief from floods to the entire Miami Valley from near the headwaters of the Miami River to the Ohio River, to the Stillwater Valley from West Milton to its outlet and to the town of Osborn on the Mad River.

The biggest item of cost in the system of storage reservoirs would be the lands taken. As the reservoirs would be empty during the crop-growing season of each year and as the ponding of the water during floods would tend to prevent soil erosion and would cause fertile mud to be deposited, the productive value of the lands within the reservoir would probably be increased. However, as it may be necessary to purchase a large part of these lands in securing right-of-way, we have included in our estimate of cost about half the total value of the lands below the water line during the most extreme floods, such as occurred last March.

A system of reservoirs the sole object of which would be complete flood prevention in the Miami Valley* would cost about $12,000,000.

We believe that the flood protection afforded by this system would be sufficient for all purposes in the Miami

*The report does not specify the storage capacity, but a statement attached to it gives the aggregate capacity of the six reservoirs as 40 billion cu.ft.

Valley. Should it appear, however, that the city of Hamilton should require further protection, it can be secured by the addition of another reservoir on Twin Creek above Germantown.

To protect the entire valley by means of reservoirs would require about half as much time as to protect Dayton alone by local works. We estimate that two to three years would be necessary to complete the construction of a reservoir system after the legal proceedings make construction possible.

In designing these reservoirs it seems desirable not to adhere closely to engineering practice in the construction of dams. The interests involved are so great that it is desirable to plan dams of heavier and larger section than is usual.

In view of the great amount of work involved in making accurate comparisons it will be some months before a final report on all methods of protection can be submitted. Our investigations have gone far enough to indicate that the cost of protection to the city by local works will be not less than $7,000,000 nor more than $10,000,000.

Collapse of an Old 5-Ft. Brick Sewer, St. Louis, Mo.*

A street cave-in, 50x110 ft., 45 ft. deep, and considerable other damage in Ferry St., between 14th St. and Blair Ave., St. Louis, Mo., was caused Sept. 20-22, by the collapse of an old 5-ft. circular brick sewer and the subsequent bursting of a 36-in. water main a short distance away from the broken sewer. The final collapse of the pavement, revealing the great cavity in the street, fortunately occurred between the hours of midnight and 5 o'clock in the morning, so that there was no loss of life or injuries to passersby.

COLLAPSE OF AN OLD 5-FT. BRICK SEWER, FERRY ST., ST. LOUIS, MO.

(From a photograph taken before the bursting of the 36-in. water main.)

The sewer was built in 1878 of common brick laid in lime mortar, and at the point of collapse was 5-ft. inside diameter and 44 ft. below the street level. The disintegration of the mortar had evidently been going on for a long time, and it is supposed that early in the morning of Sept. 20 the arch of the sewer finally collapsed, causing a great quantity of the earth filling above to be carried away before the pavement over the cavity fell in.

Two days after the sewer collapse and while repair work was under way a 36-in. water main, a short distance west, burst, allowing the escape of about 4,000,000 gal. of water within a few hours. All this water soon found its way into the broken sewer above the point of failure, immediately flooding the cavity in Ferry St. This water backed up in the sewers above, doing extensive damage. The pressure finally forced an opening through the debris into the sewer below the break, and the resulting flood increased the size of the cave-in to 50x110 ft.

In repairing the sewer the opening was too wide to allow cross-bracing, making it necessary to drive a row of piles on each side of the sewer to hold the sheathing in place. Meanwhile the damage done the sewer by the bursting of the water main and the subsequent flood it is feared may cause cave-ins at other points.

In commenting upon the cause of the failure, W. W. Horner, Principal Assistant Engineer, Sewer Department, writes:

It seems probable that the sewers affected were built in accordance with the best practice of the time at which they were constructed, and the present trouble here should be a warning to municipal engineers in general that the life of brick sewers built with lime mortar in the Seventies or earlier is about over. The closing of this particular break will be difficult and expensive, and further serious damage may result if heavy rains occur in the near future.

*From data furnished by W. W. Horner, Principal Assistant Engineer, Sewer Department, St. Louis, Mo.

Annual Convention of the American Society of Municipal Improvements

The twentieth annual convention of the American Society of Municipal Improvements was held at Wilmington, Del., Oct. 7 to 10, with President B. E. Briggs, of Erie, Penn., in the chair. Upwards of 300 members and guests were registered but the attendance at any of the sessions rarely, if ever, reached a hundred and was commonly from 40 to 70. The program was notable for committee reports rather than for papers, of which last only a half-dozen were scheduled. Most of the committee reports were of the "progress" type but a number of these indicated actual progress rather than marking time. There was a small but interesting exhibit. Altogether the convention was a marked success, notably in the opportunity given for discussion and in the trolley, boat, and automobile rides tendered by the City of Wilmington.

General Business

The Society accepted an offer from the Association for Standardizing Paving Specifications, under which the latter proposed to unite with the Society and turn over to it the funds in its treasury. This made necessary an amendment to the constitution which provides that cities may become members of the society and be represented by not more than six active members. Another constitutional amendment adopted authorizes the admission to active membership in the Society of engineers employed by counties and states.

The bylaws were amended so that hereafter there will be no committee on place of meeting but instead the choice of meeting will rest entirely with the convention. This change was made because both this year and last year the recommendations of the committee were disregarded by the convention.

As a result of the facts brought out by Mr. Folwell's

paper on municipal control of sidewalk construction and repair, the incoming president was authorized to appoint a committee on sidewalks.

Boston was chosen as the meeting place for 1914, by a vote of 30 against 12 for Dayton, Ohio, the place recommended by the committee.

In accordance with the ladder practice common in organizations like this one, Edward H. Christ, of Grand Rapids, Mich., was elected to the presidency. For secretary, C. C. Brown, of Indianapolis, who held that office a few years ago, was chosen in place of A. Prescott Folwell, who declined to serve longer.

Mr. Folwell's report for the past year showed the following membership at the opening of the convention: Active, 312; associate, 84; affiliated, 3; total, 399.

Committee Reports

The committee reports of most note came from the committee on standard specifications and its 8 subcommittees and from the committee on standard forms and its 6 subcommittees.

Standard Specifications—C. C. Brown, of Indianapolis, chairman, made a short verbal report, which in a few instances was supplemented by reports of sub-committees. The only specifications recommended for adoption were those for stone-block pavements.

Stone Block (J. C. Hallock, chairman): Mr. Hallock recommended that the society adopt, with minor changes, the granite-block specifications adopted at Pittsburgh early in 1913 by the Association for Standardizing Paving Specifications; also that the same specifications, with slight changes in their first three paragraphs, be made standard for Medina block. This recommendation was adopted.*

Brick (E. H. Christ, chairman): Mr. Christ recommended no changes in the specifications previously submitted, but advised that the paper read before this convention by Prof. Edward Orton, of Columbus, Ohio, outlining the brick paving specifications of 1913 *proposed* by the American Society for Testing Materials be referred to the subcommittee, with authority to confer with the like committee of the society just named. These two recommendations were adopted, after some discussion which showed a strong difference of opinion as to the selection of brick for sampling. Mr. Christ and some other members of the American Society of Municipal Improvements, it appears, stand for more selective sampling than does the Testing Material Committee, which seems to incline more to random or mass sampling.

Speaking on the difference just mentioned, M. R. Sherrerd, of Newark, said that where ten brick are selected at random from a whole carload, instead of sets of samples of various classes of brick in the lot, manufacturers are tempted to put some No. 2 brick in each car in the hope of working them off.

There was also referred to the subcommittee on brick-paving specifications a paper by Wm. A. Howell, of Newark, N. J., on "The Standard Abrasion Test for Paving Brick—How It Works in Newark." Rattler tests for a number of years past were summarized with particular reference to uniformity of paving brick.

Macadam and Gravel (A. H. Blanchard, chairman): On recommendation, it was voted to change the name of this committee to "Broken Stone and Gravel." The committee is collecting data.

Other Paving Specification Subcommittees: The subcommittees on Asphalt (Geo. W. Craig), Concrete (F. R. Charles) and Wood Block (J. N. Hazlehurst) submitted no reports, although Mr. Hazlehurst sent in a letter expressing his personal opinion in favor of the old specifications for preservative oil. The subcommittee on Bituminous Specifications (Linn White) is collecting data.

Sewer Specifications (E. J. Fort, chairman): A report was submitted for discussion last year and printed in the 1912 *Proceedings*. Various suggestions for changes have been received, particularly as regards reinforced concrete, but final action has not yet been taken.

Standard Forms

A committee on this subject was appointed in 1912, with A. P. Folwell as chairman. Mr. Folwell submitted a report for the main committee and for four of the subcommittees, but recommended none of the forms for final adoption except uniform bidding blanks for pavements and sewers, which were adopted by the society, as recommended by E. H. Christ. Mr. Folwell laid particular stress upon the importance of agreement upon, and use of, standard units in contract bidding and in reporting the amounts and cost of work done in each year, for the annual report. In paving, for instance, he urged that the bidding items be segregated so as to show the prices for (1) excavation, (2) concrete base, (3) curb, and (4) wearing surface. To illustrate the utter uselessness of many statistics collected and published without regard to these elements, he cited the belated census report on "General Statistics of Cities" (1909), in which the cost of brick pavements is reported in so many different ways of inclusiveness and exclusiveness of curbs, gutters, etc., as to make the figures of no use for comparative purposes.

The subcommittee forms reported for criticism, looking to further improvement, were a very compact one for Street Lighting (Geo. A. Sawin, Newark, N. J., chairman); and one for Street Cleaning and Refuse Disposal (J. T. Fetherston, Richmond Borough, New York City, chairman). The last named form is the one adopted by the American Public Health Association in 1911.*

Geo. C. Warren, of Boston, Mass., spoke heartily in favor of segregating bids into items. He also suggested the cutting out of all such phrases as "option of the engineer," saying that if the engineer could not tell in advance, for instance, where earth or other waste materials are to be deposited then the work should be paid for on the basis of the actual quantity and distance hauled.

Mr. Warren and some other members urged that concrete foundations should be paid for by the cubic yard, and not by the square yard, as proposed in the bidding forms finally adopted, since weak places may require extra thickness. Answer was made that in such cases the bids would (or could) still be on the basis of thickness, or such extra work could be paid for on the cubic yard basis. It was pointed out that where property owners

*For the benefit of some of our readers it may be stated that in 1911 and in 1912 the American Society of Municipal Improvements received various paving specifications from its committees, but hold them open for reision before final adoption. The Association for Standardizing Paving Specifications (now amalgamated with the society just named) has adopted a number of specifications. The committees of the two societies have collaborated to a considerable extent. Those interested in the specifications proposed and adopted may address C. C. Brown, Secy., American Society of Municipal Improvements, Indianapolis, Ind., for further information.

*See pp. 678-9 of our issue of Oct. 2, 1913, for some statistics reported in accordance with this form, which give a fair idea of the form itself.

pay for pavements, misunderstandings are avoided by reducing the prices to the square-yard basis.

In the light of Mr. Folwell's remarks on the lack of comparability of municipal statistics published by the Census, the delay in the latest bulletin, and further remarks as to the possibility that the collection of municipal statistics may be abandoned, the convention adopted a resolution urging that the collection of such statistics be continued, and that efforts be made to improve their character and to hasten their publication.

OTHER COMMITTEE REPORTS—Little or nothing was heard from the other committees. The one on Water-Works and Water-Supply (A. F. McCallum, Hamilton, Ont.) reported the defeat of a Minnesota bill to give the State Board of Health more power to protect water-supplies, urged the reduction of water-waste (citing Philadelphia as a "horrible example" of waste), and indorsed recent proposals to simplify sanitary water analyses.

PAPERS AND DISCUSSIONS

SEWAGE TREATMENT AT SPRINGFIELD, MO.—One of two plants put in operation a few months ago was described by Alex. Potter, of New York City, who was engineer for both. The works described include grit chambers, "two-story" settling tanks (modified Imhoff tanks) sludge beds, sprinkling filters and a small final settling chamber.

The settling tanks are of reinforced concrete and resemble a four-leafed clover in plan. They differ from accepted design in containing a number of struts and in a provision for vertical circulation from the digesting chamber to the settling chamber above it, designed to carry upward not more than 2% of all the sewage treated.

Gas-engine driven traveling distributors, running back and forth on three tracks, distribute the sewage over the sprinkling filters. These distributors were made by the Ham Baker Co., of London, England. The beds are 53¾ ft. wide and 200 ft. long and the distributors travel lengthwise. They are fed from a trough, through a siphon which travels with the distributor. These distributors were chosen, Mr. Potter stated, because of their efficiency and because they would require only 1 ft. head, as compared with 5 ft. for spray nozzles. In winter it will be necessary to cut them out and operate the filters as contact beds. At the second and smaller plant nozzles are used to distribute the sewage.

Questions asked during the discussion of the paper showed some doubts as to the unusual features of the plant, particularly the struts, traveling distributor and the semicylindrical vents from the digesting chambers.

STATE CONTROL OF SEWAGE DISPOSAL—Under the title "What Obligations Should the State Be Under to Municipalities Ordered to Purify Their Sewage," Chester G. Wigley, engineer of the New Jersey State Board of Health, suggested that advice might properly be given as to the degree of purity and the best method of attaining it in any given case and as to the division of the cost among the communities benefited. As a matter of fact, the funds at the command of state boards of health do not enable them to go far into choice of methods, and they have no powers whatever as to apportionment of benefit among the cities benefited. It should be the duty of such boards, and they should be given the power, to see that sewage works are properly operated. Personally, Mr. Wigley believed that state aid in sewage disposal would be as proper as in road construction—an opinion indorsed by James Owen, of Newark, N. J., as worthy of consideration.

MINIMUM ILLUMINATION FOR STREET LIGHTING—Joseph E. Putnam, assistant city engineer, Rochester, N. Y., advocated amount or degree of illumination rather than candle power or amount of electrical energy as a basis for judging the efficiency of street lighting and showed by lantern slides a portable device for testing illumination used at Rochester, as well as concrete lighting poles and also lighting effects on various streets.

FIRE PREVENTION—Powell Evans, chairman of the Philadelphia Fire Prevention Commission, made a protest against fire waste, pleaded for physical standardization in the fire-prevention field, and urged systematic inspection to prevent fires, as has recently been practiced, by aid of firemen, in Philadelphia. State action against fire losses is needed. The interstate character of fire losses should be recognized, national studies of the subject made and the results published. Fire prevention standards should be established by the Federal Bureau of Standards.

A paper on "Education in Fire Prevention," by F. W. Fitzpatrick, Washington, D. C., was read by title.

ROLLING STREET EMBANKMENTS—A strong plea for consolidating road or street embankments by rolling instead of relying on natural settlement was made by Geo. C. Warren, of Boston. Mr. Warren cited some examples of bad settlement and damage to pavements where reliance had been placed on natural settlement and other examples with first-class results where rollers had been used. He had even gone to the trouble and expense of lowering a steam roller into a deep ravine and rolling the fill in 6-in. layers in order to prevent settlement.

OTHER PAPERS—A paper on "Separate and Combined Sewers in Their Relation to Sewage Disposal," by John H. Gregory, New York City, and one on "Control of Sidewalk Construction and Maintenance," by A. P. Folwell, New York City, have been reserved for separate treatment. Two other papers have already been mentioned as having been read and referred to the committee on brick-paving specifications.

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The Control of Sidewalk Construction and Maintenance

The "Clearing House" of the American Society of Municipal Improvements undertakes to secure information on specific subjects for the members of the society. At the convention of the Society held at Wilmington, Del., Oct. 7 to 9 the results of an inquiry on the municipal control of sidewalk construction and maintenance were presented by A. Prescott Folwell, secretary of the Society. The paper summarized replies received from a number of engineers. The replies were classified under headings indicating the means and degree of control and the summary was followed by conclusions drawn by Mr. Folwell. We give here the names of the cities in each class and Mr. Folwell's conclusions. It should be understood that the entries in each class were necessarily somewhat arbitrary, owing to varying degrees of control. The classification is as shown on the next page.

WORK PERFORMED BY CITY—[Meaning either direct city labor or contract work at the instance of the city rather than the property owner.] Asheville, N. C.; Columbia, S. C.; Valdosta, Ga.; Richmond, Ind.; Aberdeen, Wash.; Hamilton, Ont.; Winnipeg, Man.; Lethbridge, Alberta; Victoria, B. C. (9 cities).

NO SUPERVISION—Pawtucket, R. I.;* Norristown, Penn.; Birmingham, Ala.; Fort Worth, Tex. (and probably other Texas cities); Quebec, P. Q. (9 cities.)

BONDING CONTRACTORS—Kalamazoo, Mich.; Decatur, Ill.; Ames, Ia.; Grank Forks, N. D.; Pine Bluff, Ark. (5 cities.)

INSPECTION—Binghamton, N. Y.; East Orange, N. J.; Wilkes-Barre, Penn.; Wilmington, N. C.; Charleston, S. C.; Lima, Ohio; Indianapolis, Ind.; Grand Rapids, Mich.; Holland, Mich.; Grand Rapids, Mich.; Atchison, Kan.; Manhattan, Kan.; Kansas City, Mo.; Fort Smith, Ark.; Austin, Tex.; San Angelo, Tex.; Santa Barbara, Calif. (16 cities.)

Many of the replies expressed opinions to the effect that further municipal control was necessary.

Mr. Folwell's comment on the replies is as follows:

In commenting upon these replies, the author would call especial attentfon to the arguments in favor of the method first described—that of treating sidewalk work in the same way as roadway work; and this method of treatment should, in his opinion, apply to the designing and general control as well as to the mere construction. By this he means that the material to be used and the time of construction should be determined by the department of highways or city engineer, and that the work should be put in an entire block at a time and not piecemeal.

It seems inevitable that most of the highway construction which is performed in small sections scattered over the town cannot receive as effective supervision by the city engineer as could a few contracts each covering an entire block or more. There certainly would seem to be little question that construction in 25- or 50-ft. sections must be quite a little more expensive and in many respects less satisfactory than if the entire block were constructed at one time. In addition to this, even where the work is well done, the patchy appearance of a street where old and new sidewalks alternate, and indeed where brick, flag and concrete may all be found on one block and in various stages of repair, is far from pleasing to the eye and is unpleasant for the pedestrian.

The sidewalk is as fully a part of the public highway as is the roadway, so far as its use is concerned. It is as free to the general public and is (or should be) no more used for private purposes by the abutting owner, and we can therefore see no reason why the two should receive different treatment.

As a matter of fact, in too many cases little attention is paid to the sidewalk. Volumes are written about roadway pavements, but only an occasional page about sidewalk paving; but yet to one person who uses the roadway there are probably ten who use the sidewalk. The additional property rights or quasi-ownership which in some cities are held by the abutting owner over the sidewalk need not interfere with the municipal control any more than they interfere with roadway paving in those states or cities where such ownership is construed as extending to the center of the highway.

And the logic of the argument would include also maintenance, including street cleaning. In German cities the street-cleaning gang cleans sidewalks as well as the roadway, in many cities flushing them down with hose during the night at the same time that the roadway is similarly treated. In large cities a considerable proportion of the dirt on the sidewalks is blown there from the roadway, and the remainder is carried or thrown there by the public at large, which uses the sidewalk (except for store sweepings or other dirt thrown from the abutting premises in violation of the city ordinances). It would therefore seem to be as much the city's business to remove this dirt from the sidewalks as to clean the roadways. An additional argument in favor of this is the fact that the dirt from the sidewalk is very apt to be blown or swept on to the roadway shortly after the latter has been cleaned, thus to some extent undoing the work of the street-cleaning gang; which would not have occurred had the entire street from property line to property line been cleaned at one operation.

Considering, however, merely the point of view of the cost of sidewalk construction, there would seem to be little reason to dispute the following statements: First, an improperly constructed sidewalk will be more expensive in the long run in that it must be renewed more frequently than one properly constructed. Second, inspection adequate to securing proper construction is very expensive when the work is done in small jobs of 25 or 50 ft. Third, construction in such small jobs is more expensive to the contractor and consequently to the property owner or city. Fourth, not only would it appear reasonable, but it has been demonstrated by experience, that the lowest prices can be obtained for sidewalk work by letting the contract for the work of an entire season to one or two contractors, with the understanding that no stretch of work of less than a block will be ordered.

*Geo. C. Carpenter, city engineer, stated that since he made the report to Mr. Folwell the city had assumed some measure of control.

NOTES

A Cave-in in a trench at Main and Fair streets, Paterson, N. J., on Oct. 7, caught and smothered three Italian laborers who were working on a new underground conduit for the New York Telephone Co.

A Locomotive Driving Wheel Came Off through the breaking of an axle on a passenger train on the Central Vermont Ry., near Waterbury, Vt., on Oct. 6. The driving rods broke and their revolving ends did considerable damage to the locomotive. The engineer applied the brakes and jumped off and the train was safely brought to a stop.

Heavy Floods in Southern Texas, the result of the heavy rains of the two weeks prior to Oct. 3, caused the death of a number of persons and the destruction of much property. Houston during the past 15 days has had a rainfall of 20 in. In San Antonio the water in the streets reached a depth of 4 to 6 ft., on Oct. 2, and the public service utilities suspended operations. Many bridges were washed away.

The Chicago Garbage-Disposal Situation remains unchanged. At a meeting of the city council, the Chicago Reduction Co. submitted an offer to sell its plant for $383,000, instead of the $492,500 originally demanded, but the offer was rejected. The dumping of garbage in clay holes has been commenced, but vigorous protests have been made by persons in the neighborhood of the dumping spots, mainly on the score of nuisance and bad odors. The treatment with a deodorant solution is expected to reduce the nuisance to a minimum.

A Temporary Railway Station at St. Paul, Minn., has been erected by the St. Paul Union Depot Co., on the site of the station recently destroyed by fire, and ticket office was in service on Oct. 10. The baggage and mail departments were not damaged. By Oct. 12, all the station departments were ready for service in the temporary quarters. The rearrangement of the passenger terminals and the construction of a new station have been under consideration for some years by the numerous railways interested, and the destruction of the old station may help to the acceptance of some plan for the new work.

The Trestle Approach of a Bridge Collapsed under an electric car at Green Bay, Wis., on Oct. 14. No lives were lost. The bridge over the Fox River on the line of Main St., the most heavily traveled bridge in the city, consists of a steel through-truss swing-span and a long pile-trestle approach on the west. Both trestle and steel span are old, and have long been known to be in poor shape, but nothing has been done to provide a stronger and more modern structure. Both the street cars of the city lines and an interurban line operating large and heavy cars cross the bridge. About noon, Oct. 14, a sprinkling car of the electric railway broke through the timber approach, carrying down a section about 80 ft. long. The men on the car went down with it, but were rescued. The work which collapsed was rebuilt 16 years ago.

A High Percentage of Profit on a New York State road contract—Because the State Highway Department has cancelled the contract for the Bayshore-Brookhaven State road, the contractor, Charles V. Platt, of Port Jefferson, has filed a claim against the State of New York for $132,000, which he figures would have been the profit to him resulting from the contract had it been carried out.

The contract for this road was awarded to Mr. Platt last December and the work was commenced. The contract called for thirteen miles of State road to be built at a cost of about $246,000.—"Brooklyn Eagle," Oct. 9.

A Head Collision between a train bound for Middletown, N. Y., on the Berlin branch of the New York, New Haven & Hartford R.R. and a Meriden-bound electric car of the Meriden & Middletown Ry. (owned by the New York, New Haven & Hartford R.R.), at Westfield, Conn., on Oct. 10, resulted in the death of one passenger and the injury of 11 others. There is a single track from Westfield to Middletown, Conn., which branches at the former town, one line going to Berlin and the other to Meriden, Conn. The collision occurred on this stretch of track used by both steam and the electric trains. The

train is said to have been backing (according to custom) toward Middletown at 20 mi. per hour when it struck the electric car which was running toward it at 25 mi. per hour.

A Butting Collision occurred between a passenger train and a freight engine in the yards of the Chicago, Milwaukee & St. Paul R.R., at Madison, Wis., on Oct. 6, seriously injuring 12 persons. According to press dispatches, the railroad officials blame the switching crew for the accident. The latter are stated to have said that they thought the passenger train had arrived before they ran out on the main track where the collision occurred. The passenger train was 10 min. late and was moving at about 40 miles per hour when the switch engine was sighted a short distance ahead. The baggage and smoking cars of the passenger train were partly telescoped.

Resolutions Adopted by the American Road Congress at the Detroit meeting were in substance as follows: (1) Favoring the creation of a national department of public works with a cabinet officer at its head; (2) favoring the establishment of state highway commissions and state aid for highway construction; (3) favoring the establishment of a national road system for the construction of lateral and connecting market highways by states, counties and towns; (4) favoring the appointment by the President of the United States of a commission to investigate, report on and recommend a system of Federal aid for road construction ;(5) favoring legislation to enable the nation to be officially represented at the International Road Congress; (6) favoring the investigation of applications for patents relating to road and bridge construction by the Federal Office of Public Roads before patents are issued; (7) commending the Lincoln Highway Association and the National Old Trails Association; (8) endorsing the compulsory use of wide tires and the road drag; (9) favoring the use of convicts on road construction and maintenance; (10) favoring long tenure in office of experienced and efficient highway officials.

The Milwaukee Sewerage and Sewage Disposal Plan Project, after much delay of various kinds, has at last progressed as far as the appointment of four of the five commissioners under whose direction the improved means of sewage collection and disposal are to be planned and executed. The commissioners thus far appointed are: Michael Carpenter, Theo. A. Vilter, Conrad Niederman and Geo. P. Miller. The commissioners are to receive no salaries, but must give bonds for the faithful performance of their work. They are to continue in office until the work of the commission is completed, subject only to removal for unfaithfulness or political activity. The commission is authorized to employ a chief engineer and such other technical and professional advisors and assistants, and such clerks, laborers, etc., as it sees fit, and may fix their salaries and wages and discharge them at will, except as limited by contracts with highly trained, experienced or skilled individuals. It is to be noted, however, that the state civil service laws affecting the city are to govern the commission, except as regards appointees under contract and the chief engineer and secretary to the commission.

A Large Pier and Industrial Development is proposed by the New Jersey Harbor Commission for the west shore of upper New York harbor, between Constable Point and the Greenville freight terminal of the Pennsylvania R.R. As reported upon by the Commission's engineer, B. F. Cresson, Jr., the plan calls for building out two necks of land between Greenville and Constable Point, each 1500 ft. wide and 5000 ft. long, the out shore end being at the bulkhead line. Between these peninsulas would be a basin 1000 ft. wide. It is contemplated that the government pierhead line would be drawn in until it should be parallel and 1600 ft. off shore of the present bulkhead line. It would be expected that the federal government, in view of the importance of such a terminal and the proposed location of the new navy yard and naval station nearby would dredge a channel 1200 ft. wide and 35 ft. deep along this projected pierhead line. At the end of each one of these long fills would be three piers 1600 ft. long, 200 ft. wide, with a basin 350 ft. wide between. In the middle of the fill would be a number of oblique piers 700 ft. long, 125 ft. wide and 275 ft. apart. The shore line at Constable Point also would have several long piers. In this way, provision would be made for wharfage of all classes of ships, for lighters and floats, etc. Facilities are contemplated for the direct loading of grain into holds of ships, and for the supply of ships with bunker coal. Space is provided for classification yards and railroad freight buildings, with tracks along the bulkheads and in the piers.

The S.S. "Volturno" Burned at Sea, in about 48.25 N. latitude, 34.33 W. longitude, from causes not definitely known, while on her voyage from Rotterdam to New York. According to one story the fire was started by a heavy explosion in the bow, but this has not yet been verified. Press dispatches state that of the 24 cabin and 540 steerage passengers and a crew of 93 (making a total of 657 persons on the ship), 136 were lost, and 521 were rescued by the 10 steamships which responded to the wireless distress signals from the burning ship. The first wireless calls for assistance from the "Volturno" were received at about 8:10 a.m., on Oct. 10, and at 11:45 a.m. the first of the rescue ships arrived upon the scene. The removal of the passengers and crew was impossible until the tank-steamer "Narragansett" arrived, at 7:10 a.m., Oct. 11, and reduced the roughness of the sea in the vicinity, by pouring upon it two large streams of oil. All of the passengers had been removed by a few minutes after 8 a.m., Oct. 11. About 24 hours elapsed between the time the first call for help was received and the transfer of the passengers. It is claimed that during this period the fire did not burn aft of the bridge. Apparently most of the deaths resulted from attempts to launch lifeboats from the side of the "Vulturno" into the heavy sea. Of six lifeboats lowered, only two (both of which disappeared) succeeded in clearing the side of the vessel; the other four, crowded with passengers and crew, were smashed against the hull and their occupants lost. The "Volturno" was owned by the Canadian Northern Steamship Co., but had been chartered to the Uranium line, the ships of which dock at Brooklyn, N. Y. She was built in England by the Fairfield Shipbuilding Co., in 1906.

An Improved Locomotive Terminal has been built for the Baltimore & Ohio R.R., at Cumberland, Md., by Westinghouse, Church, Kerr & Co., 37 Wall St., New York City. This place is situated at the foot of the eastern slope of the Allegheny Mountains and through here both passenger and freight traffic is heavy. Practically all the freight locomotives are of heavy mallet or of mikado type and the heaviest Pacific type is used for passenger service. The improved plant comprises a roundhouse with a 100-ft. motor-operated turntable, a double-cinder pit, a reinforced-concrete coaling station, a sand house and a small power house. To accommodate the large mallet locomotives, the roundhouse was made 110 ft. long and has 31 stalls with space for further extension. The building has brick walls on concrete foundations with timber roof posts and a wooden roof. The back wall is made up of brick pilasters with broad window spaces between, fitted with top and bottom sash counterbalanced with each other. The roof line is broken at the first row of posts near the front of the building so as to give a row of sash with narrow vertical louvres over each stall to provide light and ventilation. The engine pits are 88 ft. long with side walls for 40 ft. on the inner end wide enough for jack bearings. The pit walls extend 12 ft. outside the house to prevent track settlement. Twin driving-wheel drop pits, serving four stalls were provided and two stalls have truck wheel drop pits. These are furnished with hydraulic pneumatic jacks respectively, of 30 and 15 tons capacity. Each stall has a smokejack made of asbestos lumber supported on a wooden frame with a hood 4 ft. wide and 12 ft. long. The floor surface is half of creosoted wooden blocks and half of mastic rock, both on 6-in. concrete foundation. The building has an indirect heating system with fan capacity sufficient to change the air completely once in 15 minutes. Closely adjacent to the engine house and connected to it by a covered passageway, with a track leading to one of the stalls of the roundhouse, is a machine shop 70x140 ft. Here is equipment for light repairs. At the west end of the building is a toilet room and at the east end is a two-story office structure, 33x64 ft., providing rooms for the master mechanic, road foremen of engines, roundhouse foreman, storekeeper and clerks, and the engine dispatchers. The power house located nearby is 67x65 ft., having separate boiler and engine rooms. In the engine room is a 1000-ft. air compressor, three 50-kw. power transformers for power, a 50-kw. and a 25-kw. transformer for lighting, the latter for series arcs, and a fire pump. In the basement are the boiler-washing pumps. In the boiler room are two batteries of water-tube boilers, aggregating 1000 hp. rated capacity, with automatic stokers.

There is a cinder pit between the coaling station and the engine house. This is a double submerged type with an overhead traveling crane and grab bucket. About 120 engines are handled over the pit daily and one man working during daylight hours is able to remove all the cinders deposited. The coaling station has bunker capacity for 600 tons. There are four bins to handle three sizes of coal (run-of-mine, crushed-stoker and special-passenger). About 20 cu.yd. of dry sand can be stored overhead, and a nearby sand house has storage for 1200 cu.yd. of green sand which is dried by steam and elevated to the overhead storage bin by compressed air. All buildings are circled by a 6-in. fire line supplying

fourteen 4-in. two-way fire hydrants connected to the fire pump in the power house. Three standpipes supply water to engines passing to and from the roundhouse.

The Most Severe of Three Record Concentrated Rainfalls in New York City during the present season occurred Oct. 1. As in the two previous deluges of July 28 and Sept. 5 respectively ("Engineering News," Aug. 7 and Sept. 11) the subway system of the Interborough Rapid Transit Co. was blocked. The interruption to passenger traffic, however, was more serious in this last rain, as other transportation lines besides the subways were put out of commission. At 3:45 p.m., the subway service between 73d St. and the Grand Central station at 42d St. was discontinued. Water poured into the subway so that it soon became necessary to stop traffic as far north as 96th St. Water entered the subway at 23rd, 46th, 81st, 116th and 157th streets on the Broadway line, and at 110th St. on the Lenox Ave. line.

As in the two preceding rains, the greatest trouble occurred at Times Square. The sewers again backed up through the basement of the Longacre building, and from there to the subway platform and onto the tracks, contributing to the flood which poured down the steps of the kiosks and through the sidewalk gratings, due to the inadequacy of the catch basins in the street and of the sewers themselves, which at this point were not designed to cope with such excessive floods.

In the subway, at Times Square, four pumps, which have a combined capacity of 2000 gal. per min. operated continuously, and in addition to these a car-pump which discharged 2000 gal. per min. operated for 40 min.; but obviously the pumping system was of little avail until the pressure in the sewers relaxed, as the water was pumped into the flooded streets, only to flow back again into the subway. At 5:30 p.m., when the rain began to abate, the water at Times Square station was two feet deep over all four tracks, and at its maximum reached twice that depth. At 7:20 p.m., the first southbound train reached Grand Central station, having passed through the flooded district, and service was restored.

Shoring in the excavation of the new subway under Church St. in the vicinity of Cortland St. was washed away, resulting in the weakening of the Sixth Ave. elevated railway structure on Church St., so that trains on this line had to be discontinued below Cortland St. from 2:50 to 4:30 p.m.

In Brooklyn, the Long Island R.R. service into the Flatbush Ave. station was abandoned from 3 to 6:30 p.m., and was not fully resumed until 9:30 p.m., due to the flood at the freight depot, situated at that station. Over part of the Brighton Beach line of the Brooklyn Rapid Transit Co., service was interrupted from 3 p.m. until arter midnight. The part of this line which was in trouble passes through an open cut which was flooded. A sewer burst at Fourth Ave. and 44th St., Brooklyn, by the side of the excavation for the new subway, and dropped the street surface on which men of the Sewer Department were working, into the subway, a distance of 30 ft.

The following tabulation is a comparison of the rainfall over equal periods during the three recent rains:

INCHES OF RAINFALL

Time minutes	Oct. 1 Battery	Oct. 1 Central Park	Central Park Sept. 5	Central Park July 28
5	0.44	0.56	0.60	0.51
10	0.77	0.78	1.15	0.96
15	1.05	1.01	1.59	1.20
30	1.64	1.55	2.62	1.48
60	2.26	2.03	3.31	2.73
120	3.34	3.35	3.70	3.11
24 hr.	5.16	5.07	4.14	3.11

Final Stages of Construction on the Panama Canal—Three events of great significance in connection with the Panama Canal have occurred within the last few weeks—the successful operation on Sept. 26 of the entire flight of locks at Gatun to pass the seagoing tug "Gatun" from the Atlantic channel to Gatun Lake; the flooding of the famous Culebra cut on Oct. 1, by opening the valves of the pipes through the Gamboa dike, which has shut out the waters of Gatun Lake during the period of steamshovel work, and the final destruction of the dike by a huge blast on Oct. 10.

The first use of the locks was made on Friday, Sept. 26, in order that two of the Army Engineers, Maj. James P. Jervey and Maj. George M. Hoffman, who have had immediate charge of the work at Gatun, under Lieut.-Col. W. L. Sibert, Division Engineer, might witness the actual completion of their labors before departing from the Isthmus to their new assignments.

The filling of the lock chambers occupied a longer time than normally, because of the small displacement of the tug; in the case of a large vessel, much less water would have been used. The total lift was approximately 64.70 ft., divided between the three locks, about as follows: Lower lock, 21.2 ft.; middle lock, 23.7 ft.; upper lock, 29.8 ft.

During this operation of the locks, all of the operating devices were operated from local control, that is, each machine was operated from the panel in the same room with the machine. This made it necessary for the operator to move from machine to machine for the various operations, whereas, when the plant is completed, the entire flight will be controlled from the central control tower.

The lockage of the vessel was under the immediate supervision of Col. H. F. Hodges, the designer of the locks, their equipment and operating machinery, and the regulating works of the canal. In this he was aided by Edward Schildhauer, the Electrical and Mechanical Engineer of the Commission, and the inventor of the mechanism which opens and closes the lock gates, and E. E. Lee, Superintendent of Erection; F. C. Clark, Assistant Superintendent of Erection; C. P. Fortney, Superintendent of Mechanical Installation; S. H. Grauten, Testing Engineer, and Geo. F. Guynn, Inspector of lock gates and protective devices. The vessel had among its passengers on this initial trip, Col. H. F. Hodges, Lieut.-Col. William L. Sibert and family, Maj. James P. Jervey, and Mrs. Jervey, Maj. George M. Hoffman, Lieut. Geo. R. Goethals and Mrs. Goethals, Henry Goldmark, Captain Corning, of the steamer "Panama," Mrs. Edward Schildhauer and Mrs. E. E. Lee.

Water was admitted into Culebra cut through the four 24-in. pipes extending into the lake underneath Gamboa dike, on Oct. 1. The slide at Cucaracha has completely closed the cut, in one place to the 73-ft. level, therefore, the water discharged into the canal by means of the pipes between Oct. 1 and 10 was wholly confined to the section between the slide and the dike. To overtop the slide, it will be necessary for the water in the lake to reach a level of 73 ft. above mean sea level. A ditch will be cut through Cucaracha slide to start the water through and, it is expected that a great deal of the slide material will be washed into the drainage ditch between the slide and Pedro Miguel locks.

The drainage pumps in the cut near the dike were shut down on Sept. 24; all the machinery was removed and the building which housed it was razed. Sufficient water had collected in the cut on Oct. 1, from seepage and surface drainage to cover the bottom between Cucaracha slide and the dike.

On Oct. 10 careful preparations had been made by the Western Union Telegraph Co. and the Central & South American Telegraph Co. for the continuous transmission from Washington of President Wilson's signal, which was to cause the first blast for the destruction of the Gamboa dike. Some 1220 charges of dynamite aggregating 40 tons were exploded in all. In the first blast were 400 of these charges, weighing a total of 1600 lb., the explosion of which removed the top of the dam; the other charges were exploded later at intervals. It now remains for dredges to complete the cut.

PERSONALS

Mr. J. R. Mann has been appointed Superintendent of Transportation of the Detroit & Toledo Short Line R.R., with headquarters at Detroit, Mich.

Mr. H. H. Berry, recently Superintendent of the Western Maryland Ry., at Hagerstown, Md., has been appointed Superintendent of the Denver & Rio Grande R.R., at Pueblo, Colo.

Mr. James D. Tyter, Superintendent of the Fitchburg division of the Boston & Maine R.R., at Boston, Mass., has been promoted to be General Superintendent, succeeding the late W. F. Ray.

Mr. C. A. McCarthy, former Master Mechanic of the Chicago, Rock Island & Pacific Ry., at Shawnee, Okla., is now Master Mechanic of the Colorado Springs & Cripple Creek District Ry., at Colorado Springs, Colo.

Mr. C. C. Whittier, recently in charge of the Winnipeg, Man., branch of Robert W. Hunt & Co., Ltd., has been made Treasurer and General Manager, with headquarters at 905 McGill Bldg., Montreal, Que.

Mr. Joseph Harrington, Chief Consulting Engineer for the Green Engineering Co., Chicago, Ill., has resigned to engage in private practice with offices in Chicago. He will specialize in boiler-plant design, equipment and operation.

Mr. G. H. Folger, recently Assistant General Superintendent of the Boston & Maine R.R., at Boston, Mass., has been appointed Superintendent of the Terminal division, with headquarters at Boston, and his former position has been abolished.

Mr. W. J. Frauendiener, recently General Inspector of the locomotive department of the Cleveland, Chicago & St. Louis R.R., at Indianapolis, Ind., has been appointed Master Mechanic of the Eastern division at Bellefontaine, Ohio, succeeding Mr. J. T. Luscombe, resigned.

Mr. David B. Fleming, formerly Assistant Superintendent of the Mohawk division of the New York Central & Hudson River R.R., is now Superintendent of the Buffalo division at Buffalo, N. Y. He was born in 1877 and entered the service of the New York Central Lines in 1893 as a telegraph operator.

Mr. D. F. Schaff, Superintendent of the Chicago division of the Cleveland, Cincinnati, Chicago & St. Louis R.R., at Indianapolis, Ind., has been granted a six-months leave of absence. Mr. C. S. Millard, Superintendent of the Michigan division, will assume charge of the Chicago division temporarily.

Mr. R. N. Dickman, M. Am. Inst. M. E., Mining Engineer of Chicago, Ill., has become associated with Robert W. Hunt & Co. His headquarters will be at 2200 Insurance Exchange, Chicago. Mr. Dickman is now engaged in the examination of gypsum and coal properties in Western Canada, for the Robert W. Hunt & Co., Ltd., of Canada.

Mr. E. J. Devans, Division Superintendent of the Buffalo, Rochester & Pittsburgh R.R., at Rochester, N. Y., has been promoted to be General Superintenent in charge of transportation, with headquarters at Rochester. He is succeeded as Division Superintendent by Mr. M. G. McInerney, former Assistant Superintendent at Rochester.

Mr. F. B. Walker, Assoc. M. Am. Soc. C. E., formerly Chief Engineer of the Arizona Land & Irrigation Co., Prescott, Ariz., has been appointed Assistant Engineer of the Chicago, Milwaukee & St. Paul Ry., at Lewiston, Mont., succeeding Mr. F. J. Herlihy, whose resignation to accept a position with the Cook Construction Co., of Montreal, Que., was noted in our issue of last week.

Mr. Fred O. Dolson, recently Hydraulic and Irrigation Engineer of the Pacific Power & Light Co., Portland, Ore., for four years previously Erecting Engineer for the Pelton Water Wheel Co., has left the West coast for New York City, via the Panama Canal. He is soon to leave New York on an extended trip through South America for the purpose of introducing American machinery.

Mr. Arthur Sessions, Superintendent of Transportation of the Central division of the Panama Canal, has resigned to become General Superintendent of Transportation of the Bocas division of the United Fruit Co., with headquarters at Bocas del Toro, Panama. Mr. Sessions went to the Isthmus in 1905 as Trainmaster. He was promoted to be Assistant Superintendent of Transportation in 1906 and Superintendent in 1908.

Mr. William J. Cunningham, Assistant Professor of transportation at Harvard University, has been appointed Assistant to Vice-President (to be President as soon as the change in the railway company's by-laws is effected), J. H. Hustis, of the New York, New Haven & Hartford R.R., with offices in New Haven, Conn. Prof. Cunningham has been granted two years' leave of absence from the University, but will continue to lecture there on transportation subjects.

Mr. Searcy B. Slack, recently City Engineer of La Grange and County Surveyor of Troup County, Ga., has been appointed Adjunct Professor of civil engineering at the University of Georgia, succeeding Prof. John C. Koch, Assoc. M. Am. Soc. C. E., who is taking up special work at Johns Hopkins University, Baltimore, Md. Prof. Slack is a civil engineering graduate of the University of Georgia, class of 1911, and a Master of Arts of Harvard University, class of 1912.

Mr. W. J. Knight, Assoc. M. Am. Soc. C. E., recently Chief Engineer of the Gilsonite Construction Co., St. Louis, Mo., is now associated with Mr. G. S. Bergendahl, Assoc. M. Am. Soc. C. E., President of the Bergendahl-Bass Engineering & Construction Co., 1311 Harriss Trust Bldg., Chicago, Ill., under the firm name of Bergendahl-Knight Co., with offices at the above address in Chicago. The firm will make a specialty of reinforced-concrete and structural steel design and construction.

Mr. Henry Welles Durham, M. Am. Soc. C. E., Chief Engineer of Highways, Borough of Manhattan, New York City, has recently completed an extensive tour of investigation of paving and street maintenance work in European cities in the interests of the City of New York. Mr. Durham was appointed by the late Mayor Gaynor a delegate to the recent International Road Congress, at London, England, and by direction of the Mayor devoted the remainder of the summer to a detailed study of European pavements.

Messrs. Herbert H. Conway, a graduate in civil engineering of Cornell University, and recently in charge of the cement-testing laboratory of the Northern Pacific Ry., Tacoma, Wash., and E. T. Asplundh, a graduate in civil engineering of Pennsylvania State College and recently with the Turner Concrete Steel Co., Philadelphia, Penn., have formed a partnership under the firm name of Conway & Asplundh, Engineers, with offices at 418 Tacoma Bldg., Tacoma, Wash. They will make a specialty of reinforced-concrete building construction and design.

Mr. Albert J. Himes, M. Am. Soc. C. E., Engineer of Grade Elimination, Cleveland, Ohio, New York, Chicago & St. Louis R.R., and former Resident Engineer of the Eastern division of the New York State Canals, has been appointed Valuation Engineer of the railway company. He will be assisted by a committee, of which he is the chairman, consisting of Messrs. E. A. Miller, Superintendent of Motive Power and Equipment, and H. D. Palmer, Assistant General Counsel. Mr. Himes is a graduate of Cornell University, class of 1887, and was at one time City Engineer of Corning, N. Y. He first became connected with the New York, Chicago & St. Louis R.R. in 1901 as Bridge Engineer.

Mr. Earle B. Phelps, Assoc. Am. Soc. C. E., Assistant Professor of research in chemical biology at the Massachusetts Institute of Technology, has been appointed Professor of Chemistry and Chief of the Division of Chemistry at the Hygienic Laboratory of the United States Public Health Service, Washington, D. C. Prof. Phelps graduated in chemistry from the Massachusetts Institute of Technology in 1899 and for four years was Assistant Bacteriologist of the Massachusetts State Board of Health, at the Lawrence Experiment Station; he has been Chemist and Bacteriologist of the Sanitary Research Laboratory at the Institute since 1903, and also Assistant Professor of chemical biology. For several years past he has maintained a New York office as a consulting sanitary expert. The Public Health Service was recently authorized by Congress to make an investigation of the pollution of interstate streams, and to this work Prof. Phelps will devote the major part of his time.

OBITUARY

Alex Z. Newlin, M. Am. Soc. M. E., Mechanical Engineer of the Kewanee Works of the National Tube Co., Kewanee, Ill., died from pneumonia, Oct. 7, at his home in Kewanee. He was born in McKeesport, Penn., 37 years ago. He graduated from the McKeesport public high school in 1895, and after teaching school for three years he entered the engineering department of the National Tube Co., at McKeesport. In 1901 he was transferred to the headquarters engineering department of the company at Pittsburgh, Penn., and in 1908 was promoted to be Mechanical Engineer of the Kewanee works. He is survived by a widow, two children, his father and several brothers

ENGINEERING SOCIETIES

COMING MEETINGS

NATIONAL SOCIETY FOR PROMOTION OF INDUSTRIAL EDUCATION.
Oct. 19-25. Annual convention at Grand Rapids, Mich. Secy., C. A. Prosser, 105 E. 22d St., New York City.

AMERICAN MINING CONGRESS.
Oct. 20-25. Annual convention at Philadelphia, Penn. Secy., J. Calbreath, Majestic Building, Denver, Colo.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.
Oct. 21-23. Annual convention at Montreal, Que. Secy., C. A. Lichty, 319 North Waller Ave., Chicago, Ill.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Oct. 28. Annual Convention at Washington, D. C. Secy., Wm. H. Connolly, Interstate Commerce Commission, Washington, D. C.

NATIONAL CONSERVATION CONGRESS.
Nov. 18-20. Annual meeting at Washington, D. C. Secy., T. R. Shipp, Indianapolis, Ind.

GREAT LAKES INTERNATIONAL PURE WATER ASSOCIATION.
Nov. 6-7. Meeting at Toronto, Ont. Secy., Paul Hansen, Urbana, Ill.

UNITED STATES GOOD ROADS ASSOCIATION.
Nov. 10-16. Third annual meeting at St. Louis, Mo. Secy., J. M. Rountree, Birmingham, Ala.

NATIONAL FOUNDERS ASSOCIATION.
Nov. 19-20. Annual convention at New York City. Secy., J. M. Taylor, 29 So. La Salle St., Chicago, Ill.

ENGINEERING LITERATURE

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REVIEWS AND NOTES

A Study of One Type of Reinforced-Concrete Floor Slabs

Reviewed by MALVERD A. HOWE*

THE THEORY OF THE FLEXURE AND STRENGTH OF RECTANGULAR FLAT PLATES Applied to Reinforced Concrete Floor Slabs—By Henry T. Eddy, Professor of Mathematics and Mechanics, College of Engineering, and Dean of the Graduate School, Emeritus, University of Minnesota, Minneapolis, Minn.: Rogers & Co. Cloth; 6x9 in.; pp. vii + 104; numerous halftone plates and text illustrations. $5.

Several attempts have been made to develop a rational theory for the design of reinforced-concrete flat slab floors, all leading to more or less approximate methods. The six methods for designing the four-way reinforced flat slab, known to the writer, are not in agreement. Three methods require from two to four times the amount of steel required by the other three. The three methods requiring the smaller amounts of steel are based upon the elastic properties of the concrete and steel and probably have for a single foundation the theory of thin flat plates.

Dr. Eddy has based his investigation upon the "fundamental equations of extensional stress and strain in thin flat plates and slabs" which contain the function called Poisson's ratio.

If the assumptions are acceptable that the "actual reinforcement is regarded as distributed into a thin sheet of uniform thickness," that the concrete resists compressive bending stresses only and that the extensions or compressions in one direction are influenced by those at right angles, then the formulas developed by Dr. Eddy are very easy to follow and lead to expressions which are simple in form and easy to apply.

However much one may question the above assumptions there can be but little doubt that a reinforced-concrete slab supported on columns behaves in a manner somewhat similar to a homogeneous thin slab under like conditions of loading. Admitting this to be true, the equations developed by Dr. Eddy are of the proper form, leaving, however, the values of the function representing Poisson's ratio, that one representing the effective area of the steel and the one determining the proper arm of the stress in the steel, to be determined by the designer to fit any particular type of construction.

Unfortunately Dr. Eddy has shown the application of his formulas in detail to but one type of construction, the "standard mushroom" type (Turner's). For this type Poisson's ratio is stated to be 0.5. The accepted value of this ratio for steel is 0.3 and that for concrete 0.1; consequently it requires more convincing arguments than those given on pages 11, 12 and 13 to satisfy the reviewer that this is the average value of Poisson's ratio for reinforced concrete with the special arrangement used in the "standard mushroom" construction.

Inasmuch as the theoretical values found from the formulas using the value 0.5 agree well with experimental results, this is the proper value to use for this function for the "standard mushroom" system, but it appears more logical to simply state that the function is an empirical factor depending upon the qualities of the materials and their arrangement determined by experiment.

Representing Poisson's ratio by K the general formulas for the stress in the steel and the bending moment are as follows:

$$f_s = \frac{(1 - K^2)\, q\, b}{12\,(j\,d)\,\Sigma\,A}\,(3\,x^2 - a^2) \text{ and } M = \frac{(1 - K^2)}{12}\,q\,b\,(3\,x^2 - a^2)$$

All of the quantities are known excepting K, jd and A; jd is the "vertical distance from the center of tension in steel to center of compression in concrete" and A is the "area of cross-section of steel reinforcement per unit width of slab, in case it can be assumed to be replaced by a uniform sheet of equal weight." Any errors made in the assumption of jd and A will have a proportional effect upon the values of f_s and M, but a very considerable error may be made in assuming the value of K without seriously affecting the values of f_s and M. Therefore it is not worth while to enter into any arguments concerning the actual value of K.

As stated above the "standard mushroom" type has been worked out in detail and equations given for deflections, stresses in side and diagonal belts, points of contraflexure, points of maximum moment, shears, etc. These equations are very complete and easy to use.

The title of the book is not well taken, as aside from the twenty-odd pages devoted to the development of the general equations, the entire book appears to be a plea in favor of the "standard mushroom" type of construction. The Preface and some ten pages at the end of the book are credited to C. A. P. Turner. Twenty-one pages are taken up with a description and discussion of tests made upon a Norcross slab and a "standard mushroom" slab.

The book impresses one as a very excellent trade publication but it is not easily understood why a price of $5 should be demanded even if, as stated in the Preface, that sum "will be credited in return for it, on the larger treatise which the authors intend to complete as soon as the magnitude of the task will permit."

RAINFALL, RESERVOIRS AND WATER SUPPLY—By Sir Alexander R. Binnie, Past President, Inst. C. E. [Founded upon the Chadwick Trust Lectures Delivered by the Author at the Institution of Civil Engineers in February, 1912.] New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xi + 157; 56 plates and illustrations. 50c., net.

These lectures by one of the leading engineers of Great Britain are chiefly valuable in that they "illustrate some of the salient points connected with" water-works engineering as developed and observed by the author in the course of long practice. The principal subjects treated are rainfall, runoff, consumption per capita, sources and modes of supply, reservoir dams and reservoir outlets, aqueducts and supply mains, the distribution system, valves, meters and house fittings. Aside from the author's personal views on water-works design and construction, the volume contains comparatively little not already in print.

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The tabular and other figures and the examples of design and construction are for the most part drawn from the past, and to be of much more than historical interest need to be brought up to date. Notwithstanding these limitations, the book would be a worthy addition to fany libraries.

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A New Edition of Andrews' "Structures" and a Supplementary Volume

Reviewed by LEWIS E. MOORE*

THE THEORY AND DESIGN OF STRUCTURES—A Textbook for the Use of Students, Draftsmen and Engineers Engaged in Constructional Work. By Ewart S. Andrews, Lecturer in Theory and Design of Structures at the Goldsmiths' College, New Cross, England. Third edition. London, England; Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xii + 618; 290 text figures. 9/-, net.

FURTHER PROBLEMS IN THE THEORY AND DESIGN OF STRUCTURES—An Advanced Textbook for Use of Students, Draftsmen and Engineers Engaged in Constructional Work. By Ewart S. Andrews, Lecturer in Theory and Design of Structures at the Goldsmiths' College, New Cross, England. London, England: Chapman & Hall, Ltd. Cloth; 5x9 in.; pp. viii + 236; 99 text illustrations. 7/6, net.

An earlier edition of Andrews' "Structures" was reviewed in these pages on Apr. 14, 1910. The subject matter through the main portion has not been altered, but some new material has been added in the form of an appendix. The new material consists of a very short paragraph on repetition or variation of stresses. About three pages are devoted to a digest of Stanton's experiments on wind pressure, which give a formula and certain other results deduced from these experiments. The experiments show a certain amount of suction on the leeward side of a roof and another page is devoted to stress diagrams, using this upward or suction pressure on the roof. The next six pages are devoted to an analysis of stresses in curved beams of rectangular cross-section. About five pages are devoted to the drawing of bending moment diagrams by means of a template. Several pages are then devoted to problems illustrating deflections of beams in various special cases, a few pages are given to wind stresses in roof trusses.

In the body of the book the author still persists in the statement, to which attention was called in the previous review, that the economic depth of a plate girder is from one-tenth to one-fifteenth of the span, and in designing plate girders he counts upon one-sixth of the web as flange area, which would not be regarded as safe designing by American engineers. The value for the maximum bending moment on a stiffening truss of a suspension bridge, which the author erroneously gave as $\frac{p L^2}{54}$ in the first edition and which was noted in the previous review, is still given, but the author has added a foot-note stating that with a certain kind of loading the value of the maximum bending moment may be $\frac{p L^2}{32}$.

In general it can be said that the only change from the first edition is in the addition of 27 pages in the form of an appendix.

The second of the volumes before us is intended to supplement the one just noted. The influence line, omitted in the previous volume, is treated here in some detail, the first four chapters being devoted to it. The first two chapters deal with the application of influence lines to simply supported beams and frames. The author states at the close of the first chapter that if "the whole of an engine is under the line of the influence diagram, it will be necessary only to scale off the ordinate under the center of gravity [of the engine] to get the bending moment for the whole engine." This is manifestly incorrect, as may be seen by taking the influence line for bending moment at any point of a simple beam and assuming, for the sake of the argument, that the center of gravity of the loads on the beam happens to be at the highest point of the influence line. The sum of all the loads would, then, according to the author, be multiplied by the greatest height of the influence line, a manifest absurdity. Chapter II takes up the application of influence lines to trusses and develops a formula for finding the position of loads which produces a maximum moment at any given point. The author fails to carry his analysis to its logical conclusion, which would of course lead him to the "average load" method, but stops short with a formula which would be by no means easy to remember.

The third chapter takes up, first, influence lines for statically indeterminate beams. The end bending moments for fixed ended beams are found by a graphical method. A mathematical treatment is also given and influence lines are drawn for continuous beams of unequal spans. The chapter closes with applications of the influence line method to trusses of two spans and a continuous beam of three spans.

Chapter IV applies influence-line methods to arches and suspension bridges, beginning with a three-hinged arch. In the solution of the parabolic arch the author obtains a maximum moment equal to $\frac{p L^2}{53}$, after making an approximate solution of an equation by plotting. The reviewer believes that the denominator of this fraction should be 54, but has not the time at his disposal necessary to make an exact mathematical solution. The number 53 does not naturally occur in connection with parabolic arches and 54 as well as other combinations of the figure 9 does occur. It should be noted that a difference of 3 units in the fourth decimal place represents the difference between the values of the two fractions. The chapter continues by taking up spandrel-braced arches and two-hinged arches. The closing pages of the chapter refer to stiffened suspension bridges. The author has corrected the error in the maximum bending moment on a stiffening truss, which occurred in the volume to which this is supplemental, and which was noted by the present reviewer when he reviewed the first volume in these columns.

The deflection of trusses is next dealt with, taking up first the deflection in a single-angle bracket in the direction of the load and then treating the general case of deflection in any direction under any set of loads. Equations for giving the depth of a Warren and a Pratt truss for maximum stiffness are given. The depths which the author tabulates for various numbers of panels are considerably greater in proportion to the panel lengths than the experience of American bridge engineers indicates to be economical. The Williott diagram is explained and illustrated.

Chapter VI takes up stresses in frames having redundant members, analyzing by the method of deflections, and closes with a short paragraph on the method of least work. Chapters VII and VIII deal with arches, arch ribs and spandrel braced arches, deriving general formulas for the determination of the thrust for parabolic and circular arch ribs; and treating fixed arch ribs of parabolic and circular form.

Chapter IX treats portals and Chapter X secondary stresses. The author takes up secondary stresses in simple cases, such as roof truss shoes, and shows how the latter may be designed to avoid secondary stresses. He falls into the error, however, of making the gage lines, instead of the gravity lines, of the members intersect in a point. The treatment of secondary stresses in trusses is brief, consisting largely of a digest of an article by Prof. Turneaure, which appeared in "Engineering News" of Sept. 5, 1912. The author does not tell how to avoid secondary stresses, which is what the average practitioner wants to know.

It is perhaps not quite fair to criticise this book by itself as it is intended to supplement a previous volume and the explanations in the previous volume are often referred to. It would seem that the viewpoint of the author has been to emphasize the working of problems rather than the careful study of fundamental principles. The standpoint seems to be that of the mathematician rather than that of the designer of bridges. The mathematical work throughout is given in great detail, but the discussion of results, and the effect of differing conditions on the result, are very meagre. The book gives the impression of theoretical rather than practical knowledge on the part of the author. It would seem that the book could have been great improved had there been more discussion of conditions and had their effect on the theories been explained.

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ROAD MAKING BY CONVICT LABOR—Bulletin No. 1, National Free Labor Association, 832 Broadway, New York City. Paper; 6x9 in.; pp. 48.

This pamphlet is issued to urge the general use of convict labor in road construction and in the work of producing supplies used by the inmates of state institutions. In over half the states of the Union, the system is still in force of leasing the labor of convicts to private contractors at so much per day. The contractors use the convicts in various lines of manufacture often at a large profit. New York was the first state to adopt the "state use" principle of convict-labor employment, limiting the employment of convicts to the manufacture of articles used in public institutions. This was done by the constitution adopted in 1894. Most of the articles

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in the pamphlet relate to the use of convicts on highway work, which is common in the South and which is attracting increased attention in the North.

A Practical Handbook on Steel Designing

Reviewed by JOHN L. HALL*

STEEL DESIGNING—Being "Structural Engineering," Book III. By Edward Godfrey, M. Am. Soc. C. E., Structural Engineer, Robert W. Hunt & Co.; author of "Steel and Reinforced Concrete in Buildings," "Some Mooted Questions in Reinforced Concrete Design," etc. Pittsburgh, Penn.: The Author, Monongahela Building. Leather; 4x7 in.; pp. 492; numerous text figures and drawings. $2.50.

This handy volume will surely find a welcome among those for whom it is intended.

The author having been a student, college instructor, draftsman, inspector in mill, shop and field, and a designer of steel, has aimed to make a book that will be useful to men in these various capacities, and also to the shop foreman. It was therefore necessary for him to cover a wide field—from metal working to specifications and definitions—and it must be said to the author's credit that there is nothing in the book which cannot be easily understood by any of these, while there is much in it that can be read with profit by them all.

The book does not go into the subject of computations as one might assume from the broad title. It has very little to say upon loads and stresses, or upon theoretical phases of designing. It is rather a compendium of practical notes and comments derived largely from the author's experience. The reviewer having devoted some years to designing structural steel for buildings, he turned instinctively upon opening the book to the wind bracing of buildings, and was disappointed to find six pages of familiar illustrations, and one page of context which could be summarized by saying: "This is how these buildings are braced." Anyone equally familiar with bridge designing would probably experience similar sensations upon turning to his favorite subject, and so with other topics.

The book is profusely illustrated with line drawings of steel designs for structures and parts thereof photographically reproduced from "Engineering News" and other reliable sources. In this respect the book is eminently practical, exhibiting for the most part work which has been actually constructed.

The illustrations in general present good practice. Desirable features are pointed out, and bad details receive merited criticism. The author has views of his own upon most subjects and occasionally runs counter to accepted practice. In such cases the reader must exercise judgment in accepting or rejecting the views expressed.

The author points out many faults in specifications, and argues justly in favor of a uniform standard specification for structural steel. Whatever merits the author's specifications may be found to possess, it is not thought that the profession will be quick to adopt the work of any single engineer upon this subject, but rather will look forward to specifications to be prepared eventually by committees of our national technical societies.

The characteristic and helpful thing about the book is that it gives the result of experience rather than the product of theoretical mental processes. It is not often that a man of wide practical experience can bring himself to the point of setting out the results of his experience in an orderly way for the benefit of others, as the author has done. While it might truthfully be said that every subject touched upon in the book is treated more fully elsewhere, yet on account of the compactness and the large number of illustrations, convenience will make a strong appeal to the busy man and especially to the great majority who wish to know something about a subject and do not care to take the time to investigate it thoroughly in a more comprehensive work.

The book is about the size and shape of the Carnegie Steel Co.'s handbook. There are about 190 pages devoted to illustrations and 300 to text. Of the 33 chapters, six are devoted to notes on the general design of various structures, four are on the design of members, eight on details, three on loads and stresses, one each on estimating, inspection and tests, camber, curvature, grade, expansion and contraction, working of steel and iron, preservation of same, illustrations, general engineering data, specifications and definitions, besides an 8-page index.

From a mechanical viewpoint the book is not above criticism. The illustrations need readjustment to their new environment. Many of the letters and figures and some of the titles are upside down. The pages are closely set with rather small type and there is an absence of reference titles at the head of pages. These minor defects, however, may well be overlooked by those in search of practical instruction.

*Vice-President, Purdy & Henderson, Civil Engineers, Henry Bldg., Seattle, Wash.

Sea-Coast Protection

Reviewed by WILLIAM W. HARTS*

COAST EROSION AND PROTECTION—By Ernest R. Matthews, Borough Engineer of Bridlington (England); author with Prof. Hy. Adams of "Reinforced Concrete Construction" and with T. G. Howes Thomas of "Logarithms and Trigonometry for Engineers and Surveyors." London, England: Charles Griffin & Co., Ltd. Philadelphia, Penn.: J. B. Lippincott Co. Cloth; xiv + 147; 74 text illustrations and 34 plates. $3.50, net.

Probably nowhere else in the world has the subject of protection of coasts against erosion by sea action been given the attention it has received in England. This has arisen partly from the friable character of the material composing some of the more exposed English coasts, partly from the great "fetch" of the waves during storms, and partly from the high value of the land adjacent to some of these coasts owing to the unusual density of population.

In this country the subject has been given but little study for the cases are comparatively few where the extent of the damage would warrant the very expensive structures usually found necessary. Among these cases may be noticed the sea wall at Galveston, the shores of Lake Michigan within the limits of Chicago, and certain places on the New Jersey coast near several of the prominent summer resorts. For this reason Mr. Matthews' book has but little more than academic interest in this country.

The book is composed of three main parts which may be briefly discussed under the heads of Erosion, Sea Walls and Groynes.

The portion dealing with erosion treats first of the action of waves on the coast line in a very brief and general way, and then describes at some length the various coasts of England where erosion has been especially injurious. The information is not of very wide interest. This portion is followed by the description of a number of well known sea walls built for coast protection, most of which are from English experience, and a few are taken from the coast of Holland. The engineering profession is already familiar with many of these structures.

The portion of the book referring to groynes as an additional means of protecting and rebuilding the foreshore in front of sea walls and elsewhere refers at some length to these structures, but the subject of groynes has been given attention for many years and much has been written on the subject already. There does not seem to be much new information under this head.

The author's experiments on the action of sea water on concrete have some interest and contribute to the old controversy between those who think it injurious and those who do not. The author states that sea water has a destructive action on Portland-cement concrete and recommends the mixing of concrete with fresh water where it must be used in the sea and the ageing of it in the air whenever possible. He suggests mixing pozzuolanic material with the concrete or the use of cement without alumina. His experiments are apparently few in number and of short duration and may be objected to by some as inconclusive.

The photographs of various sea walls, particularly those showing wave action, are very interesting and the text is further illustrated by a number of well chosen cuts.

The book does not go very deeply into any part of its subject and taken as a whole is not particularly valuable, except, perhaps, as an incomplete but convenient and readable compilation of information of this kind.

THE ROLLING MILL INDUSTRY: A Condensed, General Description of Iron and Steel Rolling Mills and Their Products—By F. H. Kindl, Engineer. Pittsburgh, Penn. Cleveland, O.: Penton Publishing Co. 6x9 in.; pp. 76; 27 illustrations. Cloth, $2; flexible leather, $3.

Anyone unacquainted with the operation of rolling mills yet who desires a general idea of this branch of the iron and steel industry, will do well to read Mr. Kindl's book. It is written in a very plain and simple manner, beginning with a general description of rolling mills and their products, with a chapter dealing with the manufacture of wire and the products of wire, such as nails, spikes, netting, rivets, screws,

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staples and tacks, and another chapter on the tube and pipe industry. A chapter entitled "Finished Products" treats rapidly of the finished forms which leave the mill. These are divided into four groups: (1) bars, rods, wires; (2) structural shapes, rails, splice bars; (3) plates, sheets, and (4) forgings, armor plate, axles, wheels, tires and drop forgings.

Charts showing the method of production further simplify the explanation embodied in the text. For those interested in the economics of the iron industry, a table is given showing a comparison of the factors which dictate the production of pig iron in the United States, Great Britain and Germany.

Steam Turbines

Reviewed by H. E. LONGWELL*

THE DESIGN AND CONSTRUCTION OF STEAM TURBINES —A Manual for the Engineer. By Harold Medway Marton, author of "Statically Indeterminate Structures and the Method of Least Work." London, England: "Engineering." New York: Longmans, Green & Co. Cloth; 8x11 in.; pp. viii + 372; 523 illustrations, including 24 folding plates. $8.50, net.

This work is largely a condensation and re-arrangement of a series of articles contributed by the author to the columns of "Engineering" (London) and published in that journal during the past few years. The book is to be commended especially for its mechanical make-up. The unusually large and clear type, the liberal spacing between the lines, and the dead finish of the paper combine to make the pages restful to the eye. This is no small advantage in a book that demands the unflagging, concentrated attention of the reader.

The first half of the book is taken up with principles of design—to some extent theoretical, but consisting largely of empirical formulas and diagrams without discussion as to their probable rationalness. The Mollier diagram is used for determining the "heat drop" and steam quality resulting from adiabatic expansion. There is a good deal of fairly complicated mathematical work in this section of the book, but it does not seem to be connected up logically with the general subject matter.

Chapter XVI, on Thermodynamic Principles, is the conventional chapter on entropy, without which no author of a book on heat engines seems to think that his treatise is complete. The treatment of this subject is, if anything, a little less lucid than is usual. In discussing the entropy-temperature diagram, the author calls attention to the "remarkable" properties of the curves, in that the area included under the curve between any two ordinates is equal to the heat added during a change of condition of the substance defined by the points where these ordinates cut the curve. It is a rather loose use of language to say that an area is equal to a quantity of heat, but at any rate considering that the curve is expressly constructed to show this quantity graphically, it is difficult to see why the fact that it does show it should be at all "remarkable."

We are informed on page 25 that a certain type of turbine blade was arrived at because it was found that **"as applied to aëroplanes,** it showed a much higher efficiency" than blades of another type illustrated. (Black face type mine.)

The author has a happy faculty of putting some of his formulas in rather unusual forms which are easily remembered. For example, the formula for tangential stress in a rotating steel ring is given as

$$2\left[\frac{d}{10}\right]^2 \times \left[\frac{N}{100}\right]^2$$

in which d is the diameter in inches and N the number of revolutions per minute. It is almost impossible to forget this expression, and it is sufficiently accurate for all practical purposes.

There are short chapters on geared turbines and condensers which do not cover any new ground.

It is in the last half that the book shines particularly. This part is devoted to detailed descriptions of several different types of standard turbines as actually manufactured by leading English and Continental builders. The illustrations are copious and dimensions are given with unusual liberality. As these illustrations are made from practical and successful machines, this part of the work should prove interesting and helpful to anyone who is a student of the subject.

The methods of proportioning turbines as laid down in the first part of the book are disappointing on first reading because they appear to be to a great extent purely arbitrary. Still, if a capable designer were to analyze these methods, and satisfy himself that they are rational, they might be useful as suggesting "short cuts" for making preliminary layouts.

Taken as a whole, the book is a creditable addition to the subject.

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Telegraph Equipment

AMERICAN TELEGRAPH PRACTICE—A Complete Technical Course in Modern Telegraphy, including Simultaneous Telegraphy and Telephony. By Donald McNichol, A. M. Am. Inst. E. E., Member of Engineering Staff, Postal Telegraph-Cable Co., of New York. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xvi + 507; 421 text illustrations. $4, net.

Mr. McNichol has set forth in this volume far more details of American telegraph equipment than anyone has attempted heretofore. In spite of the title, however, there is comparatively little about telegraph practice except as is necessary to an understanding of the apparatus employed. The notable exceptions are in the sections discussing speed of signaling, testing of quadruplex systems, preventing inductive disturbance and combined telephone and telegraph service. There is nothing, as we might perhaps expect, about organization or general operating methods, traffic peaks, effect of deferred messages, operators' hours, relations of branch-office and busy trunk lines, precedence governing breaking in caling, etc., combined railway dispatching and message transmission, etc. The author has been able, naturally, to give the most particulars of the Postal company's apparatus and equipment, but wherever details are available of equipment of the Western Union company and the British Post Office, they have been used also.

About a quarter of the text relates to elementary theory of electricity and magnetism, to properties of circuits, primary and storage batteries, direct-current generators (alternating-current generators are passed over), motors, rectifiers, etc. It might be expected that one who could present descriptions of apparatus in such a wealth of detail would not at every point secure the happiest presentation of the very elementary theoretical discussions. Viewed as a whole, the elementary parts are good, but not quite as satisfactory as existing treatises on rudiments alone. Experts, in writing or talking to each other, frequently drop into looseness in the use of terms which is confusing to the beginner, as for instance when it is said (p. 119) that an alternating current of high frequency has large capacity and high self-induction. What should be said, of course is that the actual effect of capacity and self-induction in the circuits becomes greatly pronounced with high-frequency currents. (The author explains in his preface that his book is for working telegraphers of rather limited education.)

Careless proof-reading in a few places confuses the meaning also, as where semicolons displace commas.

That part of the book dealing most immediately with telegraphy, describes first power-board wiring, and then simple Morse circuits. After this come, in order, lightning arresters, line switchboards, tests (for faults, line characteristics, etc.), repeaters, duplex and quadruplex instruments, branch-office equipment, calls and annunciators, alternating-current telegraphy ("phantoplex"), and automatic and printing telegraphy. Excellent chapters are appended on minimizing the induction from neighboring high-tension lines, and on the simultaneous use of lines for telegraphy and telephony; the book concludes with specifications for copper and iron wire, aërial, underground, submarine and office cables, and specifications for construction of high-tension power lines above telegraph wires, etc.

SOLUTION OF RAILROAD PROBLEMS BY THE SLIDE RULE —By E. R. Cary, M. Am. Soc. C. E., Professor of Railroad Engineering and Geodesy, Rensselaer Polytechnic Institute. New York: D. Van Nostrand Co. Cloth; 4x6 in.; pp. ix + 136; 43 text figures. $1, net.

While evidently designed to teach engineering students facility in solving railway-curve problems and in using a slide-rule this little book will be found to be of real practical value to the field engineer. It is of very handy size and gives clearly and concisely the principal formulas for the solution of the railway curve and track problems.

The formulas have been worked into such form as to make them particularly adaptable to slide-rule computations, and if slide-rule results should not be close enough for much real fieldwork the formulas are equally adapted to logarithmic computations. The notation used throughout is the same as that used in Allen's "Railroad Curves and Earthwork," to which this little book makes a valuable supplement. Formulas and explanations for the solution of easement curve and earthwork computations by slide-rule are included. A table of trigonometric formulas forms an appendix.

Rock-Asphalt Products

Reviewed by S. WHINERY*

NATURAL ROCK ASPHALTS AND BITUMENS; Their Geology, History, Properties and Industrial Application—By Arthur Danby, Chemist and Public Consultant on Rock Asphalt and Bitumen. New York: D. Van Nostrand Co. Cloth; viii + 244. $2.50, net.

Mr. Danby's book has a clear field in engineering literature. Delano's little book on the same subject which appeared some twenty years ago is out of print and even if obtainable would not be, at this late date, of much practical value. There have appeared in the meantime, it is true, a few papers, articles and chapters of books, dealing with some phases of the general subject, but nothing attempting a full and systematic treatment.

While the use in this country of European rock asphalts for paving, never very extensive, has steadily declined, and its employment for other purposes is not very large (the importation of all asphalts from Europe being only 10,656 long tons in 1912) the matter is still of sufficient importance to claim the attention of the American engineer, who will doubtless welcome this book to his library.

In ten pages of introductory matter the author deals chiefly with the vexed question of the nomenclature of bituminous materials. He proposes that all natural bitumens and derivatives from them shall be called bitumens; the artificial or pyro-bituminous he would call pitches, while the name asphalt would be applied only to "all such substances that are impregnated—as distinct from being merely mixed—with either bitumen, pitch or a mixture of the two." This is a return to and broadening of the definition of asphalt originally claimed by Delano and the promotors of the rock asphalt industry. He would call a material made of an artificial mixture of bitumen or pitch with grit or crushed stone, macadam, presumably including under the name our American sheet asphalt pavements. It is hardly necessary to say that his system of nomenclature will not be acceptable to American authorities on the subject.

The several chapters of the book are successively entitled: Geology of bitumen and rock asphalt; appearance and physical structure; history and ancient use; modern exploitation of rock asphalt; sources of rock asphalt and bitumen; American deposits of bitumen; extraction and preparation of rock asphalt; tests and analyses; physical properties of rock asphalt; the carrying out of rock asphalt work; the carrying out of rock asphalt mastic work; macadam roads; and, other uses of bitumen.

The earlier chapters, relating quite fully and in detail to the history and development of the rock asphalt industry, the sources of the material and methods of mining and preparing it, are exceedingly interesting. The two chapters on American deposits of bitumen are not notable for either completeness or accuracy, particularly as regards the extent and importance of Cuban deposits. The 48 pages devoted to the practical use of rock asphalts in structural work will be of most utility to the American engineer.

Upon the whole the book is a very interesting one to read and will be especially so to the American engineer who has not had opportunity to visit the rock asphalt mines and works abroad and thus to acquaint himself with their many interesting details.

The reader will be likely to note that the author's statements are not always clear and consistent, particularly with reference to the classification of bituminous materials under his system of nomenclature. As an instance, the uninformed reader of the paragraphs beginning near the bottom of page 158 might get the impression that Trinidad asphalt belongs to the rock-asphalt class.

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AMERICAN STANDARD FOR FLANGED FITTINGS, Standard and Extra Heavy Pressures—Adopted Sept. 17, 1913, by the Committee of Manufacturers on Standardization of Fittings and Valves; Secretary, W. H. Douglas, 30 Church St., New York City. Paper; 7x10 in.; pp. 16; illustrated.

It will be remembered that about 1894, under the auspices of the American Society of Mechanical Engineers and the Master Steam and Hot Water Fitters Association, the manufacturers of flanged pipe fittings eliminated the existing confusion in various designs for ordinary weights by the adoption of the "Am. Soc. M. E. Standard." In 1901, the same manufacturers attempted to eliminate similar confusion in extra heavy fittings by adopting what was known as the "Manufacturer's Standard" for flange dimensions and bolting. The American Society of Mechanical Engineers and the Master Steam and Hot Water Fitters Association continued the study of flanged fittings, and in 1912 adopted the "1912 U. S. Standard" for low pressure, standard and extra-heavy pressure work. The manufacturers discovered that the new standard offered them differd in so many ways from dimensions used in the trade that they did not care to accept it. But they saw the need of revision of their designs on account of low factors of safety, and adopted the "1912 Manufacturers' Standard." There was a little sharp contention about the merits of both proposals and a deadlock for a short time, but finally through the influence of H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Co., New York City, and Chairman of the American Society Committee on Flanges, the differences were compromised in designs covered by this "American Standard of 1914." This has been adopted by the manufacturers of 90% of such equipment in this country and by the American Society Committee. The council of the Society has not formally approved this report, but is expected to do so. Certain differences still exist between this and the standard accepted by the Master Steam and Hot Water Fitters Association.

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Some Public Utility Principles

REGULATION, VALUATION AND DEPRECIATION OF PUBLIC UTILITIES—By Samuel S. Wyer, M. Am. Soc M. E.; author of "Treatise on Producer Gas and Gas Producers." Columbus, Ohio: The Sears & Simpson Co. Flexible leather; 6x9 in.; pp. 313; 47 illustrations. $5, net, postpaid.

Mr. Wyer seems to have a habit and a hobby, each good, and to have combined the results of a pursuit of the two into this book—which contains much that is also good. The habit is to read widely on a given subject, digest the salient points on index cards and arrange the cards systematically. The hobby is to reduce data and criteria to neat and clear diagramatic form.

The author says his aim has been to present "an unbiased discussion and concise compilation of the pertinent economic, engineering and legal facts relating" to "the rights" of both the Public and Public Utility Corporations. He adds that "my own argument is fortified with numerous digested opinions of experts and judicial decisions, many of the latter being from the United States Supreme Court. The book is, therefore, the summation of the amassed thought and experience of many minds covering a period of many years."

After a general introduction and some fundamental definitions, the author takes up in succession the economics of utility problems, various phases of utility regulation, depreciation, valuation, going value, etc., and the principles governing the cost of utility service. Various engineering data are then presented, and the book is closed with a few reference tables, a bibliography (really a source list), and name and subject indexes.

Outside of the 33 pages of "Engineering Data," and the author's numerous diagrams, most of the volume is direct quotation from various authors and from court decisions. Although much skill has been shown in grouping these quotations and in filling missing links with definitions and opinions by the author, the result of the plan is a rather choppy or disjointed collection of definitions and opinions, classified under certain main heads. As the quotations stand in the pages a decision of the United States Supreme Court is given no more weight by the author than that of some state court or utility commission or of some writer on law or economics. To find who the authorities cited are one must turn to the bibliography in every case, which is often trying because the thin leaves stick together.

The most serious weakness of a book composed, like this one, so largely of short quotations is that taken out of their context and with but little connecting text or explanatory comment the quotations lose force or are liable to be misleading.

A large part of the space devoted to engineering "data" is well nigh wasted with mere text-book definitions and descriptive notes that have no place in a book of this sort. Thus:

LIGHT BEAM—A collection of parallel rays is called a beam.

SEDIMENT—[In water.] This may be sand, fragments of plants or animals or ferric oxide.

Of three chapters on depreciation two are taken up with electrolysis. Here the author reprints considerable portions of several papers on the subject, throwing his book all out of balance. Elsewhere he inserts a number of pages of halftones showing forms of life destructive of wood.

Some of the diagrams are more ingenious or curious than useful.

To most engineers the chief value of the book will lie in the classified citations of and references to authorities. Most of the remainder of its contents, save some of the diagrams and tables, might have been omitted with little loss

to no one and considerable reduction in the size and cost of the book. Finally, the author's skill in condensation, in arrangement and in the preparation of diagrams deserves commendation, as does the work of the publisher.

Metallurgy as a Whole

Reviewed by WILLIAM CAMPBELL*

GENERAL METALLURGY—By H. O. Hofman, Professor of Metallurgy, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiii + 909; 836 illustrations. $6, net.

Looking over the standard works on Metallurgy it is surprising to find that there are few books treating of the subject as a whole. For many years Sir William Roberts-Austen's Introduction to Metallurgy was unique and in 1910 it was brought up to date by Harbord. In this same year appeared Fulton's Principles of Metallurgy, an excellent work, in which the physical-chemical side of the subject first received the attention it deserved.

The present volume aims to cover the field of general metallurgy as a whole, under the following heads: Properties of Metals, Alloys, Metallic Compounds, Ores, Fuel, Refractory Materials, Pyrometallurgical, Hydrometallurgical and Electrometallurgical Processes and Apparatus, Mechanical Metallurgical Operations, Metallurgical Products, Economic Considerations.

To the metallurgist and advanced student the book will be welcome as a fitting introduction to the detailed study of the metallurgy of iron, copper, lead and silver, gold, zinc, etc., all of which are covered by special volumes. In fact this volume is the first of a series by Professor Hofman, covering copper, iron and steel, lead, etc. And from this standpoint the first few chapters on metals, alloys and metallic compounds are of special interest.

Of more general interest are the chapters on fuel and refractory materials. The section on pyrometallurgical processes and apparatus deals in a very clear manner with roasting and roasting furnaces, followed by an excellent discussion on slags, and then takes up smelting in the various types of furnaces, blast furnace, reverberatory, crucible, retort and converter. Then follow two short chapters on hydro- and electro-metallurgical processes and apparatus, giving a general idea of the principles of lixiviation and precipitation and amalgamation, and of electrolytic work.

To the engineer, however, it is the mechanical side of the subject that appeals. In the old days a metallurgical plant was generally characterized by a lot of small units in which metallurgy rather than engineering was the prime factor and here our metallurgy was developed. Anyone visiting one of our modern plants, be it an iron and steel works or a copper smelter, is immediately struck by the fact that the efficient handling of material in quantity is now the important thing, and here we have to acknowledge that the engineer must of necessity take the main credit. Fifty-ton ladles and ingots of 150 tons, tilting furnaces holding 250 tons of metal, blast furnaces producing 600 tons of metal a day, to say nothing of our huge forges and presses and rolling mills, are the products of the engineer.

A book that emphasizes the mechanical processes follows the tendency of present-day metallurgical practice and here we have 350 pages devoted to the mechanical side of the subject. This section is subdivided into Ores, Metal Alloys, Liquids and Gases. A clear account is given of the crushing and grinding of ores in breakers, stamps, rolls, pans and mills, followed by classification, concentrating and briquetting. Next comes the mechanical treatment of metal by rolls, hammers and presses. Under the heading of Liquids, the author discusses pumps, mixers and filtering devices. Under Gases come air-supply and method of producing blast, preheating and drying of air and purification of gases by the various methods.

The book is uniform with others in the series issued by the same publisher. It is well illustrated and printed and a distinct contribution to metallurgical literature.

SAFETY FIRST—By George Bradshaw, Safety Engineer; author of "Prevention of Railroad Accidents." New York and London: McGraw-Hill Book Co. Stiff paper; 5x8 in.; pp. 130; 99 illustrations. 50c. net.

The many railroad accidents continually occurring and the army of lives which they annually claim, should serve to strengthen the slogan which forms the title of this little book. With just enough text to give point to its 99 illustrations, the book is a pictorial warning to all railroad yard and shop men to not be foolish in the performance of their many operations, each with its element of danger. There are many photographs showing the right and the wrong method (as regards safety) for performing the principal yard operations, e.g., switching and coupling, and there are illustrations of safety devices applicable to the machine shop and to the rolling stock. It is a little book, but a big subject.

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The Disposal of Trade Wastes

A TEXT-BOOK ON TRADE WASTE WATERS: THEIR NATURE AND DISPOSAL—By H. Maclean Wilson, Chief Inspector, and H. T. Calvert, Chief Chemical Assistant, West Riding of Yorkshire Rivers Board. Philadelphia, Penn.: J. B. Lippincott Co. London: Charles Griffin & Co., Ltd. Cloth; 6x9 in.; pp. xii + 340; 74 text illustrations, including 22 plates. $5, net.

The names and the wide experience of these authors in the control of the discharge of trade wastes into waters within a great manufacturing district are in themselves no small guarantee of the value of their book. The authors state that their object has been to present in "concise form material which has been gathered in many years' experience of the working of the Rivers Pollutions Acts," and that they have sought to do this by so describing trade processes "as to show the origin and nature of polluting waste liquids" and "the means which have been found useful in" their purification.

After the historical and legal review so familiar to readers of British books on sewage treatment, the authors take up in succession wastes from the coal trade, gas manufacture, brewing and distilling industries, leather, paper, textile and miscellaneous trades. The textile trades are given more than a hundred pages. Following the chapter on specific trade wastes and their treatment is one on pumps, screens, tanks, filters, etc., another on the discharge of trade wastes into public sewers (on which there is much to be said regarding British experience and conditions) and finally a chapter on methods of analysis and limits of impurity.

Bibliographies at the end of each chapter are valuable features of the volume. Illustrations from trade catalogs are a minor blemish, but these and line cuts together aid materially in understanding the devices described. The value of the book would have been increased had more been given in the way of experiment and practice elsewhere, and had there been more in the nature of general summary and conclusions, but the book is exactly what it pretends to be, and as a description of problems and their solutions which have come within the experience and observation of the authors, it is a valuable addition to the books on the important and troublesome question of the disposal and treatment of trade wastes.

LABORATORY MANUAL OF TESTING MATERIALS—By William Kendrick Hatt, M. Am. Soc. C. E., Professor of Civil Engineering and Director of, and H. H. Scofield, Assistant Professor in, the Laboratory for Testing Materials of Purdue University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 135; 29 text figures. $1.25.

About one-third of this book is composed of description of testing machines and instruments, definition of terms, statement of phenomena appearing in mechanical testing, etc. The remainder, the main part of the text, is a systematic set of instructions for making all the common mechanical tests; on metal, on wood, on cement, on concrete aggregate and a road-metal. Appended sections contain a compilation of formulas, a table of required qualities of iron and steel and the full text of the cement specification (both of the American Society for Testing Materials), sketches of standard forms of testpiece for steel, and a table of strength figures.

The book appears to be useful for instruction purposes exclusively. The general information contained in the first part of the book is rather too short and sketchy for any but the college student's use, and, of course, the synopsis of tests also is of use only in the college laboratory. While the book thus does not appeal to the engineer, many laboratory instructors are likely to find it a useful tool in handling their testing classes.

CONCRETE ROADS AND PAVEMENTS—By E. S. Hanson, Editor "The Cement Era"; author of "Cement and Tile." Chicago, Ill.: The Cement Era Publishing Co. Cloth; 5x8 in.; pp. 227; numerous illustrations. $1.

So much interest is felt by engineers and others engaged in road construction, in the use of concrete as a road material, that a first-class and authoritative work on this subject should meet a wide sale. The present book, as the author himself says in his preface, "is frankly a compilation." An engineer who is himself fairly well posted on the use of concrete for road construction may find the book useful for reference, especially as it contains a number of the specifications which have been adopted where concrete paving has been largely used on roadways. The layman or the undiscriminat-

ing engineer, however, will be more or less puzzled to know what constitutes good practice in concrete road work, in view of the wide variation in practice described in this book. The most valuable part of the book is its record of the work which has actually been done by various cities and counties in the construction of concrete roads.

A German Book on Harbors and Docks

Reviewed by WILLIAM W. HARTS*

SEEHAFENBAU—By F. W. Otto Schulze, Professor des Wasserbaues an der Technischen Hochschule in Danzig. Vol. II, Ausbau der Seehafen. Berlin, Germany: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. x + 523; 574 text illustrations. 24 marks.

The volume entitled Sea Por Works (See hafen bau) by Prof. F. W. Otto Schulze, is an excellent exemplification of the thoroughness and care for which the German technical book is so widely and so justly praised. It represents the second part of a larger book on the construction of seaports (Ausbau der Seehafen) and is composed of four chapters, each of which is subdivided into several parts.

The first chapter deals with breakwaters, moles, training walls and piers. It covers first various types of breakwaters and piers having steep sides, such as the timber breakwaters at Rival, the timber-crib breakwaters in the Great Lakes in this country, and breakwaters partly of wood and stone, such as those at Great Yarmouth and Libau.

Breakwaters built of masonry walls with stone or concrete hearting and more particularly those founded on concrete placed under water in sacks or tremies are next described at length with many examples, among which are noticed again several designs used on our Great Lakes. Further examples are taken from English ports, such as those at Blyth, Aberdeen, Newhaven and Sunderland.

Concrete block construction is then taken up and descriptions are given of the well known breakwaters in which both inclined blocks are used, such as in the Colombo breakwater and those where the blocks are set vertically as at Ymuiden. Recent experience in floating concrete caissons is also given at some length with reference to several examples where this method has been successfully used.

The second division of the first chapter describes moles and breakwaters with sloping sides and includes among others many stone breakwaters such as that at Delaware Bay. It includes a discussion of the action of waves on such breakwaters and describes in much detail the designs and methods of construction of many of the important breakwaters of this kind in various parts of the world. It also includes those built partly of random stone and partly of masonry or concrete blocks such as the breakwaters at Sandy Bay, Cette and Naples.

This division of the chapter is followed by descriptions of breakwaters for combined types of construction where the foundation is of random or sorted stone and the superstructure is of concrete or masonry. The use of cellular concrete blocks, which has been increasing of late, is very fully described.

The outer ends of all moles and piers when exposed to storms are often points of heavy sea attack and usually require great strength. The next division of the chapter treats of these pierheads and illustrates various methods of construction with references to existing works, showing the method adopted for strengthening such outer ends.

Probably the most valuable part of the first chapter is that which describes the method of handling the construction of such works as have been mentioned before. This part is stated in much detail and contains many valuable suggestions for both designing and constructing engineers.

The second chapter deals with bank protection, dolphins and anchor-buoys. Various methods of holding the banks against sea-action, including the construction of landing places, are described, followed by a discussion of the calculations for the construction of quay-walls which in its turn is followed by descriptions of various classes of quay walls on piles, on concrete and on masonry foundations.

Attention is called to the many classes of cellular concrete work and floating concrete caissons which have been recently found satisfactory. A part of the chapter offers many useful hints in the matter of such structural details as fender-piles, ladderways, mooring-posts, etc. The latter part of the chapter is devoted to pile-dolphins and various kinds of anchor-buoys.

The third chapter deals with wharf facilities such as track arrangements, sheds and warehouses in commercial ports. Warehouse construction, including grain elevators, is gone into at considerable length and with much detail.

The fourth chapter deals with loading and unloading devices and other mechanical port appliances. Detailed descriptions are given first of various kinds of unloading cranes, elevators and capstans, etc. Attention is paid to various mechanical devices for unloading ships to shore, those for loading ships from the shore, and those used from ship to ship.

The work is thoroughly illustrated with over 500 cuts showing the practical application of the principles expounded. These cuts are unusual in their clearness. The contents of the book are arranged in a systematic and logical sequence that will be appreciated by the technical reader. Although the references are mainly to structures in foreign countries, engineers in this country would be much helped by the many excellent suggestions offered and descriptions of existing works whenever they have any construction of a similar character under their charge.

THE ELEMENTS OF SPECIFICATION WRITING—A Text-Book for Students in Civil Engineering. By Richard Shelton Kirby, Professor of Civil Engineering, Pennsylvania College. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. vii + 125; $1.25, net.

A better and more concise statement of the character, contents and purpose of this book than the author himself has given in the preface would be beyond the power of the reviewer. The author writes substantially as follows: This is a text-book on the art of specification writing, not a collection of specifications, and is the outgrowth of a series of lectures to the senior class in civil and sanitary engineering in the Sheffield Scientific School of Yale University.

The text treats of the fundamentals of a contract—particularly of a construction contract with its attendent plans and specifications; advertisement and information for bidders; essentials of a proposal and methods of bidding; general clauses; practical suggestions on specific (or technical) clauses, and a classified list of references, largely to recent articles in the more readily accessible technical journals.

General clauses of specifications are given thorough exposition, from the engineer's viewpoint. Many interesting cases illustrating their application to actual construction work are cited and discussed. Numerous and varied model clauses are quoted. Outlines of specific clauses for nine simple construction projects are given to assist the novice who writes his own specifications. Such in brief is the author's outline of his own book, and upon examination we find it to come fully up to the outline.

The text is admirably well written, and the typography is excellent. Many pitfalls not only of the beginner, but often of the experienced engineer, are interestingly brought out, and the often overlooked need of absolute fairness to the contractor is well emphasized. Apt quotations and illuminating incidents from recent technical literature add much to its readability. The reference list of articles in recent technical journals on contracts, contractors and specifications is evidently well selected and systematically arranged, and alone makes this little book worthy of a place in any engineer's library.

PURE IRON VS. COPPER-BEARING STEEL: A Brief for the Plaintiff, with Historical Data Bearing upon the Development of Rust-Resistant Metals in the United States—By Allerton S. Cushman, Director. Washington, D. C.: Institute of Industrial Research. Bulletin 5. Paper; 6x9 in.; pp. 47.

During the past few months several articles have been published in various metallurgical journals putting forth the theory that a small percentage of copper in steel made it resistant to corrosion. If this is indeed true, the discovery is one of great importance since a very considerable proportion of commercial steel at the present time contains small amounts of copper and the addition of copper to steels not containing it in the small amount required would be both easy and inexpensive. The above pamphlet on this subject by Dr. Allerton F. Cushman, Director of the Institute of Industrial Research, Washington, takes the ground that the claims made for copper in steel as an inhibitor of corrosion have no good ground. Mr. Cushman also defends iron made with the lowest possible percentage of impurities as probably the best metal to resist corrosion thus far produced. He gives an interesting historical summary of the recent literature discussing the corrosion of irons and steels.

An itemized summary of all the bids for the construction of the dual subway in New York City, received by the Public Service Commission of the First District from Oct. 27, 1910, to

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Aug. 19, 1913, has been compiled by the General Contractors Association (51 Chambers St., New York City) and is published as a supplement to the bulletin of the Association for September, 1913. Including typical cross-sections of the subway, the supplement contains slightly over 100 pages. There is also a folding map. The plan of tabulation includes first the quantities, then in succession the unit, the classification by kind of work or materials and the price and amount for each item. This information is given by bidders and the total of the bid by each contractor is also given.

Safety of Industrial Workers

Reviewed by R. R. POTTER*

SAFETY METHODS FOR PREVENTING OCCUPATIONAL AND OTHER ACCIDENTS AND DISEASE—By William H. Tolman, Director of the American Museum of Safety, and Leonard B. Kendall. New York: Harper & Brothers. Cloth; 6x9 in.; pp. viii + 422; 69 illustrations and 21 diagrams. $3, net.

SAFEGUARDS FOR THE PREVENTION OF INDUSTRIAL ACCIDENTS—Edited by David Van Schaak. Second edition. Hartford, Conn.: Aetna Life Insurance Co., Accident and Life Liability Department. Paper; 6x9 in.; pp. 187; 168 text illustrations. 50c., net.

The authors present this book on "Safety" as the only comprehensive work on the subject in the English language. It adds practically nothing to what has already been published in technical and other periodicals but claims a place in literature as a collection into one volume of current knowledge on the prevention of industrial accidents. It will appeal to that portion of the general public which has awakened to the importance of this subject of industrial safety, and as a handbook of practical information it will be of value to those directly engaged in the various industries, through its descriptions of the thorough methods for securing safety employed by some of the larger corporations.

Part I, on General Conditions, comprises three chapters on the Philosophy of Safety, Neglected Factors and the Working Place. The Philosophy of Safety reduced to its lowest terms seems to be that it is much cheaper to prevent accidents then to pay damages.

It is a surprising thing to note in this chapter that Mr. Tolman has arrayed himself with those who set up a straw effigy of what they imagine to be the modern movement for industrial efficiency and then kick it over in triumph.

In all the talk of efficiency which is flooding the country, experts overlook the human element. Efficiency which concerns itself merely with speeding up the man so as to approximate the precision of the machine, requiring one motion where he made two before, will more and more tend to make the man of not much more value than the cog on the wheel. * * * True efficiency must rest on accident prevention, improved hygiene and mutuality.

It is amusing to the reviewer of even a small number of books to see how the particular penny of each successive author hides the sun for him. Another place in the same chapter where the authors go out of their way to make a mistake is where they state that "impure water may not always produce typhoid, but almost invariably does produce stomach and bowel disorders."

Under the head of Danger Zones, Part II includes chapters on yards, walks, railings and hoists; cutting and grinding tools; illumination; fire, transportation; safety committees; iron and steel; mines and mining; electricity; general aids to safety, and organized effort by employers. It appears that "danger zones" is a term of considerable scope. The first five chapters listed are made up largely of emumerations of means and methods of obtaining greater safety in the various fields considered. A few statistics are given of classified accidents and of the decrease of accidents following from the introduction of the safeguards. These chapters are written in a somewhat monotonous style and will be found rather dry reading to anyone not vitally concerned.

One of the most interesting chapters is that on Safety Committees which explains the organization of the committees of safety of the United States Steel Corporation and of the Pennsylvania R.R. Co. Further information on this subject is included in the chapter on Iron and Steel. The Chapter on Mines and Mining deals largely with the safeguards and safety methods of the H. C. Frick Coke & Coal Co., which it is stated have been endorsed and commended by the U. S. Bureau of Mines. Similarly the chapter on electricity consists for the most part of a description of the precautionary methods of the New York Edison Co. The last paragraph of this chapter in particular could scarcely be improved upon by the Edison Co.'s own publicity man.

The chapter on General Aids to Safety gives statistics of the causes of industrial accidents taken from the annual report of the North German Iron & Steel Association. These are followed by some discussion of the causes of accidents. Considerable emphasis is placed on the importance of creating a proper mental attitude among employees toward the subject of safety and various methods for developing this attitude are outlined. The chapter on Organized Effort by Employers consists chiefly of an account of the efforts toward accident prevention of the National Electric Light Association, National Metal Trades Association, National Association of Manufacturers and some of their member companies.

Part III, on Industrial Hygiene, has chapters on committees on sanitation, industrial poisons, chemical industries and shop sanitation. In the first chapter, the organization and work of the sanitation committees of the U. S. Steel Corporation and the Tennessee Coal, Iron and Railway Co. are discussed.

Part IV on Social Welfare is of more general interest than the earlier sections of the book and appears to have been more carefully or at least more intelligently prepared. At the same time one questions why so much space should be given to such subjects as the education of apprentices, vocational schools, etc., in a book on safety to workers. In the chapter on Something More Than Wages, it begins to dawn upon the reader that Safety, in the sense in which it is used by the authors, is not at all confined to the usual field of industrial safety. It is rather a viewpoint, from which to regard all commendable activities bearing upon the welfare of industrial workers. Under the pretense of social and economic safety, there is introduced an account of Sir Wm. Lever's industrial community of Port Sunlight, Mr. Edward Cadbury's village community of Bournville (both in England) and the several Krupp colonies in Germany. The chapter on After Hours branches out frankly upon the subject of social betterment among industrial workers with no attempt to regard it as another branch of safety. Finally in the closing chapter is presented a most interesting account of the organization and activities of the American Museum of Safety.

The chief criticism of the book is that of inferior classification and arrangement of its contents. This is particularly in evidence in Parts I and II which seem to reveal a hasty preparation. In the chapters dealing with mechanical contrivances for preventing accidents, there is room for large improvement in the way of rearrangement, elimination of repetition and the introduction of helpful subheadings. The book as a whole, while of much interest and value, leaves the reader with a well defined sense of disappointment—a feeling that as the acknowledged leader of the movement for industrial safety in this country, preparing the first comprehensive work on the subject in the English language, Mr. Tolman has scarcely made the most of his opportunity.

The Aetna company's book on "Safeguards" is one that could well have been taken by Mr. Tolman as a model for that part of his book which has to do with mechanical contrivances for the prevention of accidents. The safeguards are classified according to the mechanical nature of the apparatus with which they are to be used under the following headings; gears; belts and pulleys; flywheels and driving chains; set screws, sprocket wheels and chains; rolls and knives; punch presses, grindstones and emery wheels; stairways, platforms and runways; woodworking machinery; elevators. Special chapters are devoted to the Electrical Hazard and to Contracting. Each device is both concisely described and illustrated by a clear half-tone or line-cut showing sufficiently well its construction and purpose.

The book opens with a discussion of the general causes and contributory conditions which give rise to accidents. These causes are classified as follows: ignorance, carelessness, unsuitable clothing, insufficient lighting, defects of machinery and structures, insufficient room, uncleanly conditions, lack of good air, absence of safeguards. This discussion is followed by a number of pages of general suggestions on safeguarding, and then comes the classified catalogue of mechanical safeguards. The final chapters present specimen rules and regulations, warning notices, etc., and a general discussion of workmen's compensation laws and of industrial insurance. The text is characteriezd throughout by the generous use of subheadings in boldfaced type, and these together with the systematic arrangement of the contents make it a book which is both easy to read and convenient for reference.

THE OHIO VALLEY FLOOD OF MARCH-APRIL, 1913 (Including Comparisons with Some Earlier Floods)—By A. H. Horton and H. J. Jackson. Water Supply Paper 334. Washington, D. C.: United States Geological Survey. Paper; 6x9 in.; pp. 96; illustrated.

The Geological Survey has compiled the very scanty available data concerning floods in the Central States streams, "for the convenience of the public and particularly of the

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engineering profession, and to emphasize the necessity of immediately starting, on a comprehensive scale, the collection of stream-flow data in the Ohio Valley." The pamphlet includes chiefly: Rainfall records for the flood of last March, flood-flow figures (for the Ohio River only, no figures or estimates for tributaries involved in the 1913 floods), similar figures for some earlier floods, gage heights for all the known high floods of the Ohio, a statement of the origin and occurrence of the March flood, an estimate of the damage done by the flood, some flood-wave profiles (only Ohio River for the 1913 flood), and photographs from the flood districts. The estimate of money damage (Ohio, Indiana and Illinois) is $180,000,000; but this includes the round figure of $100,000,000 for Dayton, and also it is not clear whether such items as railway loss are included, so that the estimate does not carry much weight.

THE RAILWAY LIBRARY, 1912—A Collection of Noteworthy Addresses and Papers, Mostly Delivered or Published During the Year Named. Compiled and Edited by Slason Thompson, Director. Chicago, Ill.: Bureau of Railway News and Statistics, Railway Exchange Building. Cloth; 6x9 in.; pp. 470. 50c.

This is the fourth annual compilation by Mr. Thomson of some of the important articles and addresses appearing during the year bearing on current events in the railway world. Among the twenty-five articles in the volume are two by Charles Colson, of France, the eminent economist and engineer, two by members of the Interstate Commerce Commission and several by presidents of railway companies. The selections of articles cover quite a wide range, and many of them are so valuable that they well deserve to be bound in permanent form instead of lost, as would ordinarily be the case, in the vast mass of current newspapers and periodicals.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ABSTRACT OF CURRENT DECISIONS ON MINES AND MINING, October, 1912, to March, 1913—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 82.

AGRICULTURAL DRAFTING—By Charles B. Howe. [Wiley Technical Series for Vocational and Industrial Schools.] New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 11x8 in.; pp. vii + 63; 43 text illustrations and 26 plates. $1.25, net.

AMERICAN ROAD BUILDERS' ASSOCIATION—Proceedings of Dec. 3, 1912, together with Reports of the Executive Committee, Secretary and Treasurer of Feb. 7, 1913. New York: The Association, 150 Nassau St. Paper; 6x9 in.; pp.; $15; illustrated. $2.

AMERICAN SOCIETY FOR TESTING MATERIALS—Index to Proceedings, Volumes I-XII (1898-1912). Philadelphia, Penn.: Prof. Edgar Marburg, Secretary, University of Pennsylvania. Cloth or half-morocco, 6x9 in.; pp. 158. Cloth, $1.50; half-morocco, $2.

AUSTRALIAN COMMONWEALTH OFFICIAL STATISTICS—Population and Vital Statistics, Bulletin 30, and Commonwealth Demography, 1912, and Previous Years. Melbourne, Australia: Commonwealth Bureau of Census and Statistics. Paper; 8x12 in.; pp. 247.

BRITISH COLUMBIA DEPARTMENT OF LANDS—Report of Water Rights Branch for 1912. Victoria, B. C.: J. F. Armstrong, Acting Comptroller of Water Rights. Paper; 7x10 in.; pp. 120; illustrated.

BULLETIN OF THE ALUMNI COUNCIL OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—Report of the Executive Committee on a Course in Business Engineering [Reprinted from "The Technology Review," Boston, July, 1913.] Boston, Mass.: Walter Humphreys, Secretary, Alumni Association, 491 Boylston St. Paper; 7x10 in.; pp. 20.

CANADA DEPARTMENT OF MINES—Annual Report on the Mineral Production of Canada During the Calendar Year 1911. Ottawa, Ont.: John McLeish, Chief of the Division of Mineral Resources and Statistics. Paper; 6x10 in.; pp. 316.

CANADA MINISTERE DES CHEMINS DE FER ET CANAUX—Report Annuel 1912. Ottawa, Can. Paper; 7x10 in.; pp. 335; illustrated; accompanying maps in envelope.

CANADIAN CANAL STATISTICS FOR SEASON OF NAVIGATION, 1912. Ottawa: Department of Railways and Canals. Paper; 7x10 in.; pp. 111.

CARBONIC ACID GAS CYLINDERS IN SERVICE—Report on Recent Investigations, Made to The Compressed Gas Manufacturers' Association by Messrs. H. L. Scarcke and J. C. Minor, Jr. New York City: John J. O'Rorke, Secretary, 25 Madison Ave. Paper; 6x9 in.; pp. 52; 28 text illustrations.

COLORADO SCIENTIFIC SOCIETY PROCEEDINGS—Vol. X, pp. 265-278, Investigation of Roof-Shale Dust with Reference to Its Adaptability as a Deterent in Coal-Dust Explosions—By Richard C. Hills. Vol. X, pp. 279-414, Report of the Committee on Uniform Mine Accident Laws. Denver, Colo.: The Society. Paper; 6x9 in.; illustrated. Two pamphlets.

CONCILIATION AND ARBITRATION IN THE BUILDING TRADES OF GREATER NEW YORK—Washington, D. C.: Bureau of Labor Statistics. Paper; 6x9 in.; pp. 95.

CONSERVATION OF NATIONAL RESOURCES—Report of the Conservation Committee of the American Unitarian Association, 25 Beacon St., Boston, Mass. [Social Service Series.] Bulletin 28. Paper; 5x7 in.; pp. 25. For free distribution.

CYANIDE PRACTICE 1910 TO 1913—Edited by M. W. von Bernwitz. San Francisco, Calif.: "Mining and Scientific Press." London: "The Mining Magazine." Cloth; 6x9 in.; pp. 732; numerous illustrations. $3, net.

DESIGN OF PLATE GIRDERS—By Lewis E. Moore, Assoc. M. Am. Soc. C. E.; Associate Professor of Structural Engineering, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 285; 82 text illustrations. $3, net.

DETERMINATION OF SULPHUR IN ILLUMINATING GAS—By R. S. McBride, Assistant Chemist, and E. R. Weaver, Laboratory Assistant. Washington, D. C.: Bureau of Standards. Technologic Paper 20. Paper; 7x10 in.; pp. 46; illustrated.

ECONOMIC MINERALS AND MINING INDUSTRIES OF CANADA—Ottawa: Department of Mines. Paper; 6x9 in.; pp. 77; illustrated.

ECONOMICS OF BUSINESS—By Norris A. Brisco, author of "The Economic Policy of Robert Walpole;" Departmental Editor for Canada "Book of Knowledge"; Department of Political Science, College of the City of New York. New York: The Macmillan Co. Cloth; 5x8 in.; pp. xiv + 390. $1.50.

ENGINEERING AS A PROFESSION; Scope, Training and Opportunities for Advancement—By A. P. M. Fleming, M. I. E. E., and R. W. Bailey, Principal of the Technical Institute, Crewe. London, England: John Long, Ltd., Norris St., Haymarket. Cloth; 5x8 in.; pp. xii + 288. 2/6, net.

ERNEST KEMPTON ADAMS FUND FOR PHYSICAL RESEARCH—Publication No. 4, Graphical Methods [A Course of Lectures Delivered in Columbia University, New York, October, 1909, to January, 1910]—By C. Runge, Professor of Applied Mathematics, University of Göttingen. Publication No. 6, Researches in Physical Optics, with Especial Reference to the Radiation of Electrons; Part 1—By R. W. Wood, Professor of Experimental Physics, Johns Hopkins University. New York: Columbia University. Two pamphlets. Paper; 10x13 in.; pp. 148 and 134, respectively; illustrated.

FARM GAS ENGINES—By C. F. Hirshfeld, Professor of Power Engineering, and T. C. Ulbricht, Instructor, Department of Power Engineering; Sibley College, Cornell University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. vii + 239; 188 text illustrations. $1.50 (6/6) net.

FLOOD CONTROL ON THE LOWER MISSISSIPPI RIVER: An Address Delivered before the Alumni of the University of the South, at Sewanee, Tenn., by Albert S. Caldwell, Memphis, Tenn.: Mississippi River Levee Association. Paper; 6x9 in.; pp. 15.

FORMULAE AND TABLES FOR THE CALCULATION OF ALTERNATING CURRENT PROBLEMS—By Louis Cohen. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. x + 282; 69 text figures. $3, net.

HYDRAULIC TURBINES; With a Chapter on Centrifugal Pumps—By R. L. Daugherty, Assistant Professor in Sibley College, Cornell University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 151; 96 text figures. $2, net.

INDIANA SANITARY & WATER SUPPLY ASSOCIATION—Proceedings of Feb. 25-26, 1913. Indianapolis, Ind.: Dr. W. F. King, Secretary. Paper; 6x9 in.; pp. 187.

INTERNATIONAL RAILWAY FUEL ASSOCIATION—Proceedings of Fifth Annual Convention. Chicago, Ill.: C. G. Hall, Secretary, 922 McCormack Bldg. Paper; 6x9 in.; pp. 328.

INVESTIGATIONS OF DETONATORS AND ELECTRIC DETONATORS—By Clarence Hall and Spencer P. Howell. Bulletin 59. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 73; illustrated.

JIGS AND FIXTURES; A Reference Book Showing Many Types of Jigs and Fixtures in Actual Use, and Suggestions for Various Cases—By Fred H. Colvin, M. Am. Soc. M. E., Associate Editor, "American Machinist," and Lucian L. Haas, M. Am. Soc. M. E., Tool Designer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. vii + 168; 391 text illustrations. $2, net.

JOURNAL OF THE IRON AND STEEL INSTITUTE—Edited by George C. Lloyd, Secretary. Vol. LXXXVII. No. 1, 1913. London, England: The Institute, 28 Victoria St., S. W., and E. & F. N. Spon. New York City: Spon & Chamberlain. Cloth; 6x9 in.; pp. 774; illustrated.

LA IRRIGACION DEL VALLE DE ICA—By C. W. Sutton, M. Am. Soc. C. E., Chief Engineer, Peruvian Irrigation Service. Lima, Peru: Cuerpo de Ingenieros de Minas; Jose J. Bravo, Director. Cloth; 7x10 in.; pp. 197; illustrated.

LAYING OUT FOR BOILER MAKERS AND SHEET-METAL WORKERS—A Practical Treatise on the Layout of Rollers, Stacks, Tanks, Pipes, Elbows and Miscellaneous Sheet Metal Work. Second edition. New York: Aldrich Publishing Co. Cloth; 10x13 in.; pp. 302; numerous text illustrations. $5.

LEHRBUCH DES MASCHINENBAUES—Herausgegeben von Karl Esselborn. Zweiter Band: Dynamomaschinen und Elektromotoren; Hebemaschinen; Baumaschinen; Wasserkraftanlagen; Bearbeitungsmaschinen. Leipzig and Berlin: Wilhelm Engelmann. Paper; 8x11 in.; pp. xvi + 671; 1028 illustrations. 30 Marks.

LEITFADEN DER FLUGTECHNIK; Für Ingenieure, Techniker und Studierende—By Siegmund Huppert, Direktor des Kyffhauser-Technikums, Frankenhausen a. Kyffh. Berlin: Julius Springer. Cloth; 6x9 in.; pp. ix + 368; 235 illustrations. 12 Marks.

LETTERS AND RECOLLECTIONS OF ALEXANDER AGASSIZ, With a Sketch of His Life and Work—Edited by G. R. Agassiz. Boston and New York: Houghton, Mifflin Co. Cloth; 6x9 in.; pp. 454; numerous plates and other illustrations. $3.50, net.

THE LIFE WORK OF EDWARD A. MOSELEY IN THE SERVICE OF HUMANITY—By James Morgan. New York City: The Macmillan Co. Cloth; 6x9 in.; pp. ix + 378; 7 plates. $2, net

MACHINES ROTATIVES A TRES GRANDES VITESSES (TURBINES, COMPRESSEURS ET DYNAMOS) — Par Maurice Leblanc. [Extrait des Mémoires de la Société des Ingénieurs Civils de France, Bulletin de février 1913.] Paris: La Société, 19 Rue Blanche. Paper; 6x9 in.; pp. 117; illustrated.

MAINE WATER STORAGE COMMISSION—Third Annual Report, 1912. Augusta, Me.: Cyrus C. Babb, Chief Engineer. Cloth; 6x9 in.; pp. 261; illustrated.

MASSACHUSETTS BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS (Boston, Mass.)—Twenty-Eighth Annual Report for 1912, Including Tables from Annual Returns for Year Ending June 30, 1912. Paper; 6x9 in.; pp. 717.

MECHANICS AND HEAT: An Elementary Course of Applied Physics—By J. Duncan, M. I. Mech. E., Head of Department of Civil and Mechanical Engineering, Municipal Technical Institute, West Ham; author of "Applied Mechanics for Beginners" and "Steam and Other Engines." New York: The Macmillan Co., London: Macmillan and Co., Ltd. Cloth; 5x8 in.; pp. xiii + 381; 214 text illustrations. $1, net.

METALLOGRAPHIC TESTING—Circular No. 42. Washington, D. C.: Bureau of Standards. Paper; 7x10 in.; pp. 16.

MINING AND TREATMENT OF FELDSPAR AND KAOLIN in the Southern Appalachian Region—By A. S. Watts. Bulletin 53. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 170; illustrated.

MINISTER OF MINES OF BRITISH COLUMBIA—Annual Report for 1912. Victoria, B. C.: Bureau of Mines. Paper; 7x10 in.; pp. 349; illustrated.

NATIONAL ASSOCIATION OF PORT AUTHORITIES OF THE UNITED STATES—Proceedings of First Meeting, New York City, Dec. 9, 1912; with Constitution. New York City: W. J. Barney, Assistant Secretary, 29 Broadway. Paper; 6x9 in.; pp. 75.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS (Trenton, N. J.)—Report for 1912. Pp. 504. Abstracts of Report made by Public Utilities to the Board and published as part of the Report for 1912. Pp. 289. Paper; 6x9 in.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS—Report of the Chief Commissioner for the Year Ended June 30, 1913. Sydney, N. S. W., Australia. Paper; 8x13 in.; pp. 66; 2 folding maps.

NEW YORK PUBLIC LIBRARY—List of Works Relating to the Development and Manufacture of Typewriting Machines. Paper; 7x10 in.; pp. 18.

NEW YORK STATE PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT—Report for Year Ended Dec. 31, 1911: Vol. III, Statistics of Gas and Electric Companies. New York City: The Commission, 154 Nassau St. Cloth; 6x9 in.; pp. 526.

NEW YORK STATE PUBLIC SERVICE COMMISSION, SECOND DISTRICT (Albany, N. Y.)—Sixth Annual Report, 1912. Cloth. Vol. I, 6x9 in.; pp. 1020. Vol. II, 9x12 in.; pp. 412.

OHIO STATE HIGHWAY DEPARTMENT—Eighth Annual Report for Year Ended Nov. 15, 1912. Columbus, O.: James R. Marker, State Highway Commissioner. Paper; 6x9 in.; pp. 276; illustrated.

PERMANENT INTERNATIONAL ASSOCIATION OF NAVIGATION CONGRESSES—Report of the XIIth Congress, 1912. Brussels, Belgium: Executive Committee, Office of General Secretary, 38, Rue de Louvain. Cloth; 6x9 in.; pp.xvi + 674; illustrated.

THE POLYTECHNIC ENGINEER—Vol. XIII (1913). Published annually by the Students of the Polytechnic Institute of Brooklyn, N. Y. Cloth; 6x9 in.; pp. 138; illustrated.

POWER PLANT TESTING: A Manual of Testing Engines, Turbines, Boilers, Pumps, Refrigerating Machinery, Fans, Fuels, Lubricants, Materials of Construction, etc.—By James Ambrose Moyer, M. Am. Soc. M. E., Professor of Mechanical Engineering, Pennsylvania State College and in Charge of the Engineering Experiment Station. Second edition, rewritten, enlarged and entirely reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 486; 393 text figures. $4, net.

PRACTICAL PHYSICS FOR SECONDARY SCHOOLS: Fundamental Principles and Applications to Daily Life—By N. Henry Black, Science Master, Roxbury Latin School, Boston, Mass., and Harvey N. Davis, Assistant Professor of Physics, Harvard University. New York: The Macmillan Co. Cloth; 5x8 in.; pp. ix + 487; 465 text illustrations and several plates. $1.25.

PRELIMINARY REPORT OF THE OHIO FLOOD BOARD, with Memorandum from the Chief of Engineers, U. S. A. [Report by Lieut.-Col. Francis R. Shunk, for the Board, dated May 26, 1913; Memorandum by Gen. Wm. T. Russell, dated Sept. 30, 1913.] Washington, D. C.: House Doc. No. 246. Paper; 6x9 in.; pp. 8.
An abstract of this report was published on pp. 725 and 726 of our issue of Oct. 9, 1913.

PREVENTION AND CONTROL OF DISEASE—By Francis Ramaley, Professor of Biology, and Clay E. Giffin, Instructor in Surgery; University of Colorado. Boulder, Colo.: The University Store. New York: G. E. Stechert & Co. Cloth; 6x9 in.; pp. 386; illustrated. $3, postpaid.

THE PREVENTION OF WASTE OF OIL AND GAS FROM FLOWING WELLS IN CALIFORNIA, With a Discussion of Special Methods Used by J. A. Pollard—By Ralph Arnold and V. R. Garfias. Washington, D. C.: Bureau of Mines. Technical Paper 42. Paper; 6x9 in.; pp. 15; illustrated.

PRINCIPLES OF INDUSTRIAL ORGANIZATION—By Dexter S. Kimball, M. Am. Soc. M. E., Professor of Machine Design and Construction; Sibley College, Cornell University; author, with John H. Barr, of "Elements of Machine Design," "Industrial Education," etc. Cloth; 6x9 in.; pp. xiv + 272; 19 plates and text figures. $2.50, net.

REPRINTS FROM BULLETIN OF THE BUREAU OF STANDARDS, Vol. 9—No. 200: New Calorimetric Resistance Thermometers. By H. C. Dickinson, Associate Physicist, and E. F. Mueller, Assistant Physicist. No. 202: Note on Cold-Junction Corrections for Thermocouples. By Paul D. Foote, Laboratory Assistant. Paper; 7x10 in.; pp. 483-492 and 1-13; illustrated.

ROBERT FULTON, ENGINEER AND ARTIST; HIS LIFE AND WORKS—By H. W. Dickinson, Assoc. M. I. Mech. E., Assistant Keeper, The Science Museum, South Kensington. New York: John Lane Co. London: John Lane, The Bodley Head. Cloth; 6x9 in.; pp. xiv + 333; numerous plates. $3, net.

SANITARY OFFICERS OF THE STATE OF NEW YORK—Proceedings of Dec. 4-6, 1912. Albany, N. Y.: New York State Department of Health. Paper; 6x9 in.; pp. 272.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION—Proceedings of June 26-29, 1912. Part II, Vol. XX. Ithaca, N. Y.: Prof. H. H. Norris, Secretary, Cornell University. Cloth; 6x9 in.; pp. 508; illustrated. $1.25.

SOUTH AFRICA MINES DEPARTMENT—Annual Report for 1912. Part I by Secretary for Mines and Commissioner of Mines for Natal. Part II by Government Mining Engineer. Capetown, S. A.: The Department. Paper; 8x13 in.; pp. 182; 33 tables. 10/6.

STANDARD REGULATIONS FOR MANUFACTURED GAS AND GAS SERVICE—Second edition; superceding Circular No. 32, entitled "State and Municipal Regulations for the Quality, Distribution and Testing of Illuminating Gas." Washington, D. C.: Bureau of Standards, Paper; 7x10 in.; pp. 170.

STANDARD SPECIFICATIONS FOR EXTERIOR PLASTERING (STUCCO)—Associated Metal Lath Manufacturers, 812 Wick Bldg., Youngstown, Ohio. Paper; 6x9 in.; pp. 11; illustrated.

THE STATUS AND PROFESSIONAL RELATIONS OF THE ENGINEER—A Discussion held at meetings of the American Institute of Consulting Engineers, Dec. 18, 1912, and Mar. 11, 1913. New York City: Eugene W. Stern, Secretary, 101 Park Ave. Paper; 6x9 in.; pp. 92.

SUR LE TRANSPORT ELECTRIQUE DE L'ENERGIE PAR COURANTS ALTERNATIFS A TRES HAUTE TENSION—Par M. Maurice Leblanc. [Supplement au Bulletin de la Société Internationale des Electriciens.] Paris: Gauthier-Villars, Quai des Grands-Augustus, 55. Paper; 7x10 in.; pp. 71; illustrated.

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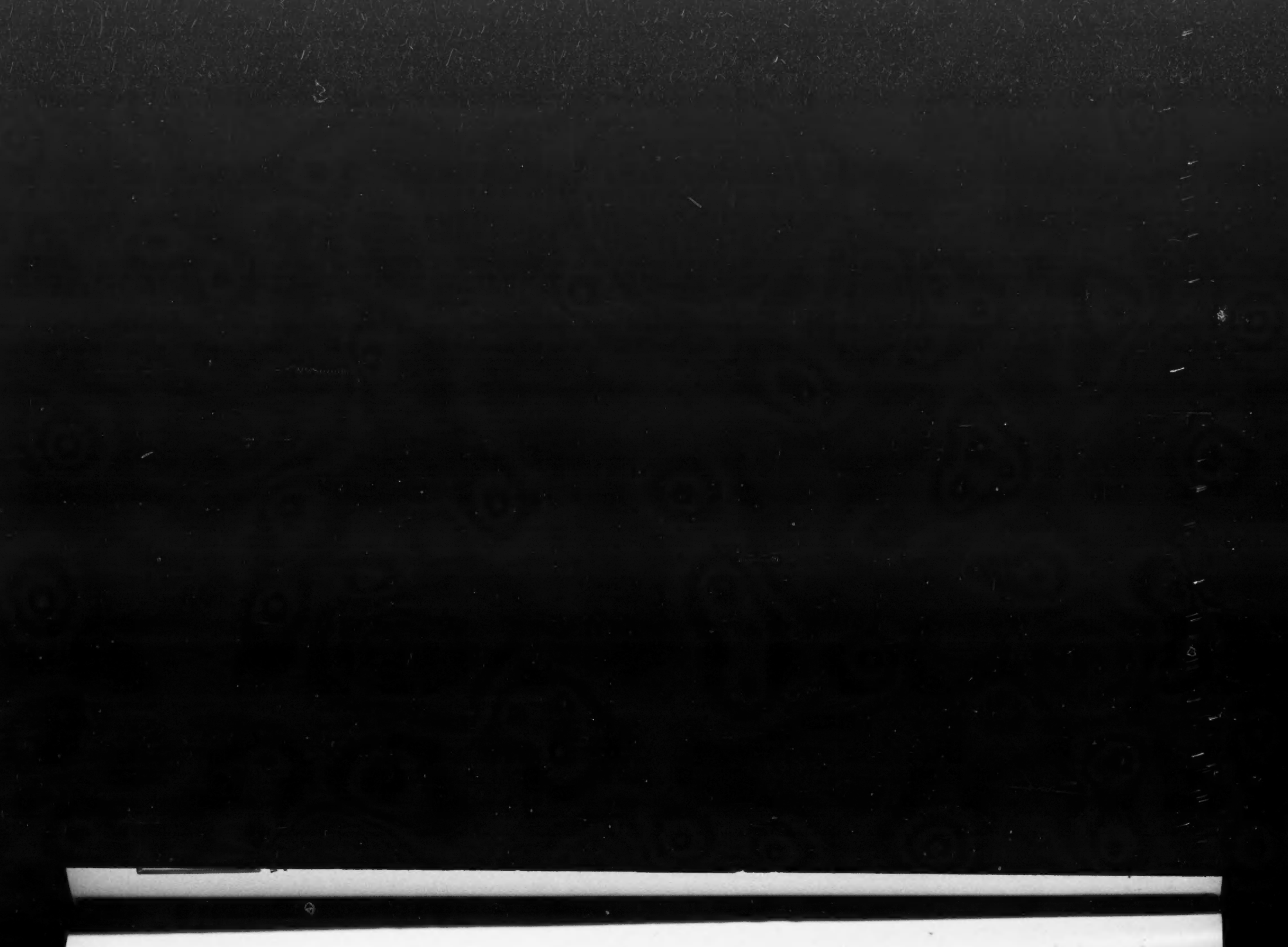
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